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# THE AZYGOS LOBE OF THE LUNG

BY

ARTHUR J. BENDICK, M.D. AND H. WESSLER, M.D.

Associate Radiographer Associate Physician and Associate Radiographer

Mt. Sinai Hospital

NEW YORK CITY

THERE are few shadows which appear on the roentgen film of the chest, of which an experienced roentgenologist cannot offer a fairly accurate interpretation, be these shadows due to normal anatomical structures or the result of disease. For this reason, any unusual shadow for which no satisfactory explanation can be offered, is a challenge to the interpretative skill of the roentgenologist and will leave him uneasy until he has arrived at a solution of the problem. We, and presumably others, have for years observed a unique shadow in the region of the right upper lobe, the exact significance of which was unknown to us and which, therefore, gave rise to considerable speculation.

This shadow was first described and illustrated by Wessler and Jaches,[1] and although its meaning was not clear to them, they regarded it as due to some anatomical structure, perhaps a congenital anomaly, because of its invariable position on the right side. Since then Velde[2] has also described this shadow and although he suggested that it might be due to an accessory or so-called azygos lobe of the lung, he had no autopsy material to test the truth of his suggestion. More recently Hjelms and Hutlén[3] have reported a number of these shadows and have also come to the conclusion that they represent the outline of the azygos lobe of the lung. These are the only references to the subject in the literature and none of these observers have been able to follow any of their cases to autopsy.

Recently, by a fortunate circumstance, we have been enabled to study two lungs at post mortem in which this shadow appeared on the roentgen film and it is possible, therefore, for the first time to state definitely that this shadow is due to an accessory lobe of the right lung known as the azygos lobe.

The shadow to be described is seen exclusively in the region of the right upper lobe. It appears as a very fine convex line beginning at the apex of the lung and extends downward to approach the mediastinum at about the level of the second costal cartilage. There is at times a slight depression at the apex of the lung where this line begins, and it terminates in a dense ovoid shadow about the size of a pea (Fig. 1). In position it shows considerable variation, as it sometimes lies close to the mediastinum, whereas in other cases

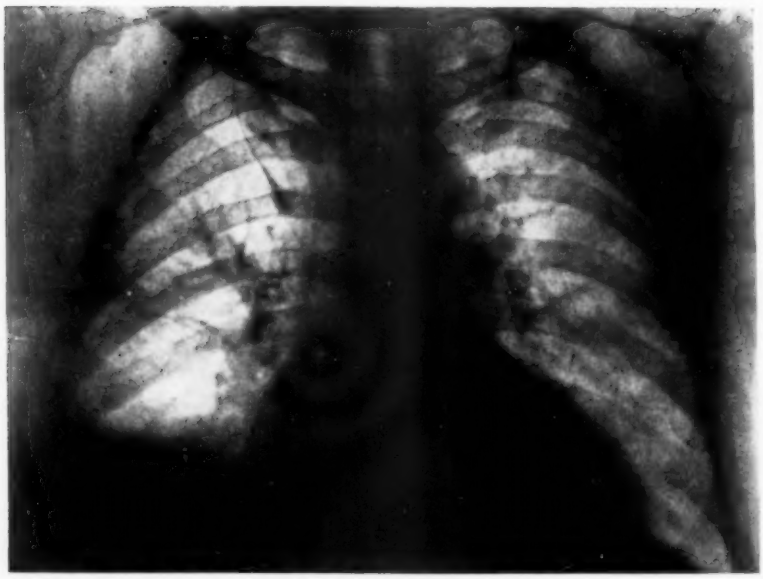

Fig. 1. Well-developed azygos lobe showing line of azygos fissure with shadow of azygos vein at its lower end.

its convexity extends far outward toward the axilla. These variations in position are illustrated in Figures 2, 3 and 4.

Fig. 2. Azygos lobe.

The azygos lobe[1] has been known to anatomists since its first description by Wrisberg in 1778. According to the commonly accepted explanation, it owes its origin to a persistence of the fetal position of the azygos vein which lies lateral to the spine. As a result of this, in its passage

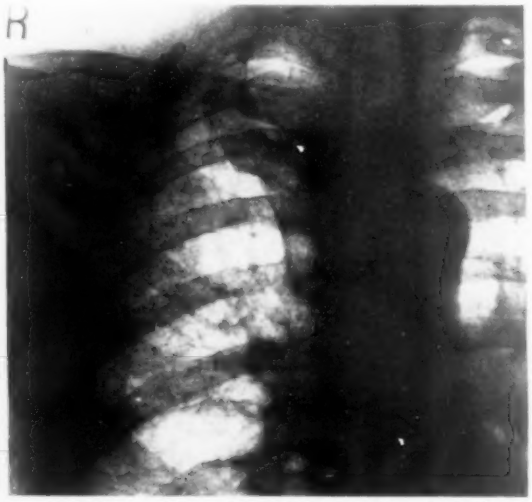


Fig. 3. Azygos lobe with thickening of apical pleura.

from the posterior chest wall to its point of entrance into the superior cava, it must traverse the substance of the right upper lobe. It carries with it a reflection of the parietal pleura which persists as a thin membrane which occupies the fissure between the azygos lobe and the rest of the upper lobe. The linear shadow above

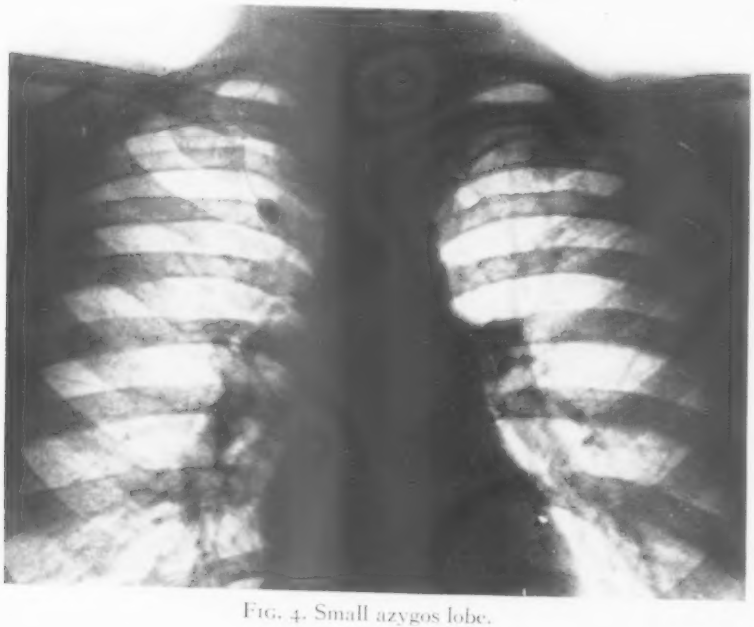

Fig. 4. Small azygos lobe.

described corresponds in position to the fissure between the lobes. The azygos vein occupies the lower part of this fissure and

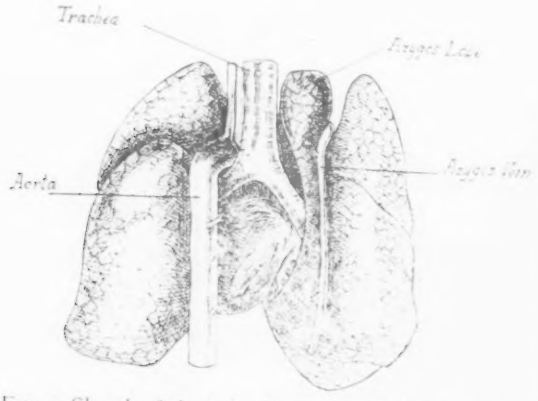


Fig. 5. Sketch of thoracic viscera from behind, showing persistent fetal position of the azygos vein with the formation of azygos lobe. (Modified from Vildes, J., *Acta Universitat. Latviensis*, 1924, ix.)

the denser ovoid shadow at its termination must then be interpreted as due to the confluence of this vein with the superior vena cava (Fig. 5). As will be seen from the illustrations, the size of the azygos lobe varies considerably. The smaller lobes which are situated near the mediastinum may be almost entirely obscured by the superior cava. This is the case in Figure 8.

The two cases which came to autopsy are the first in the literature, to our knowledge, in which the roentgen shadow of the azygos lobe has been thus confirmed.

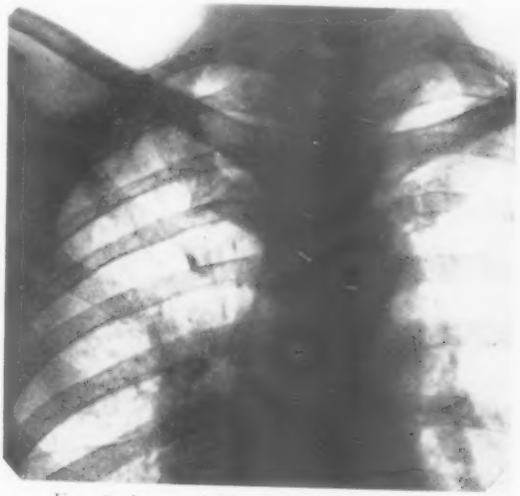

Fig. 6. Azygos lobe confirmed by autopsy.

In neither case did the accessory lobe bear any relation to the cause of death, which was in the one case due to a carcinoma of the lung and in the other the result of an empyema.

The first case was an adult in whom an azygos lobe of considerable size was found. Its roentgen appearance is shown in Figure 6 and the corresponding roentgen picture

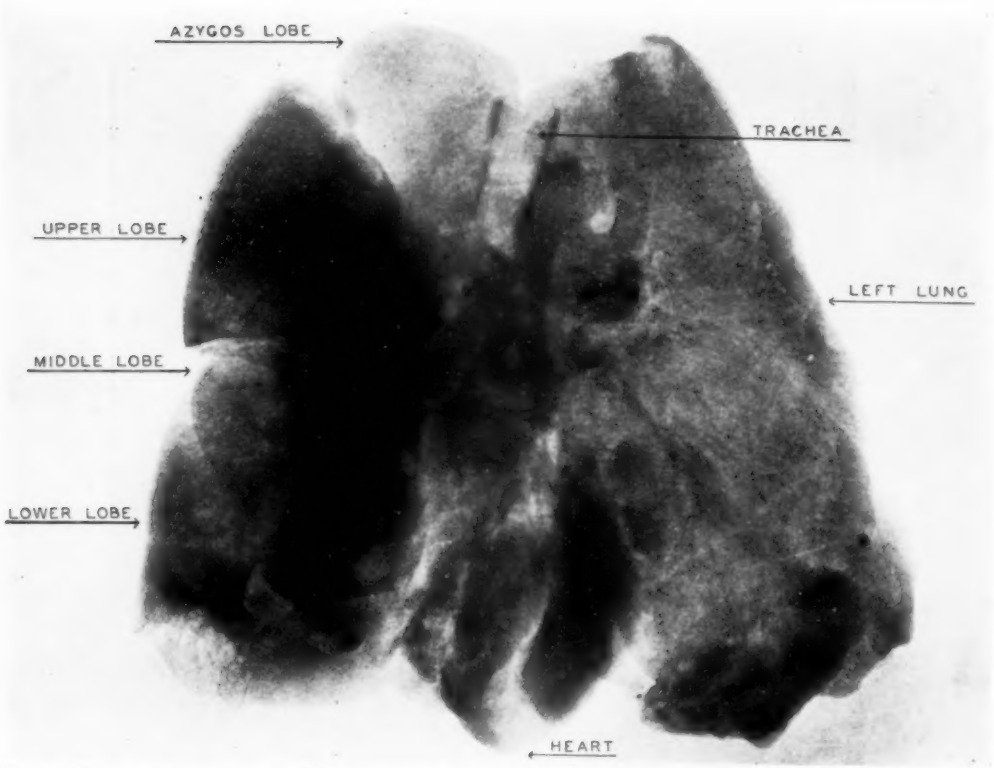


Fig. 7. Roentgen appearance of lung removed at autopsy, showing azygos lobe. Same case as Figure 6.

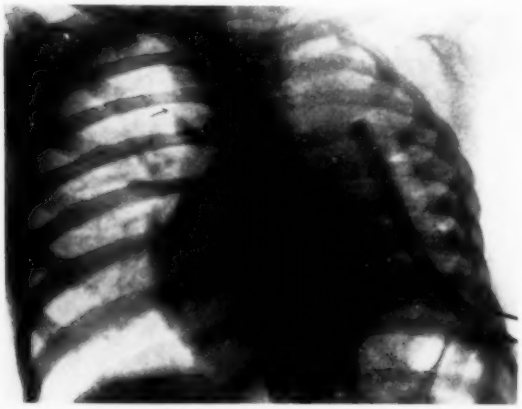

Fig. 8. Azygos lobe in child, partly concealed by vena cava. Arrow points to confluence of azygos vein and vena cava. Empyema on left side.

Fig. 9. Photograph of lung removed at autopsy showing small azygos lobe. Same case as Figure 8.

of the lung removed at autopsy, in Figure 7. In this case there was a slight thickening of the pleura over the fissure. Unfortunately, a careful dissection was not made in order to determine the position of the azygos vein.

The second case was a young child in whom the azygos lobe was so small that it was barely visible on the roentgen film (Fig. 8). Its appearance is well shown in the photograph of the lung removed at

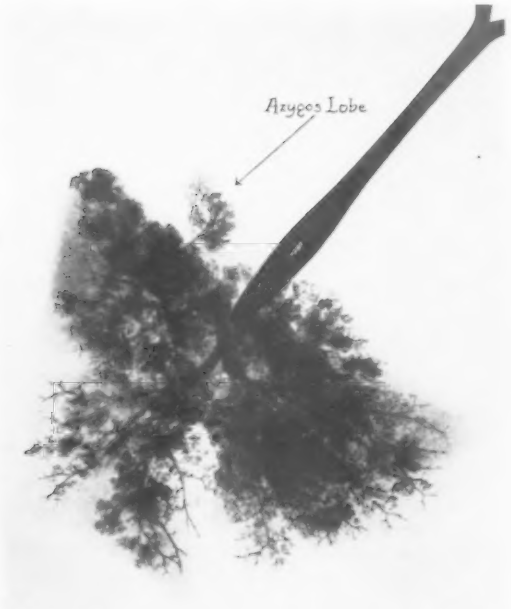


Fig. 10. Injection of bronchial tree of lung shown in Figure 9 showing small branch of eparterial bronchus which supplies the azygos lobe.

autopsy (Fig. 9). In order to bring out the relation of this lobe to the upper lobe

Fig. 11. Effusion in azygos fissure in a case of carcinoma of the lung.

bronchus, the bronchial tree was injected, showing that the azygos lobe was supplied by a branch from the eparterial bronchus (Fig. 10). This indicates that the accessory lobe was not a primary developmental defect of the lung, as in that case it would have been supplied by a separate branch from the right main bronchus.

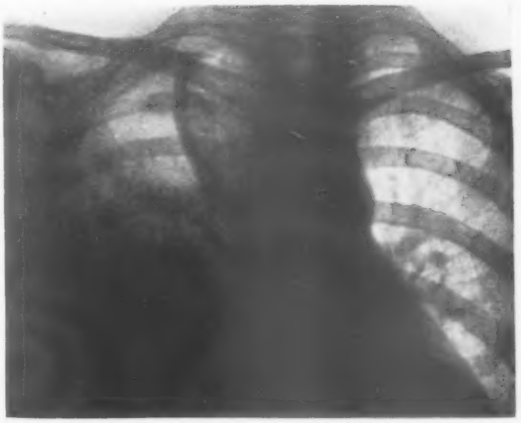

Fig. 12. Same case as Figure 11 showing increase of the effusion in the azygos fissure after one week's interval. Effusion also in general pleural cavity.

The azygos lobe does not derive its entire interest for us from the fact that it is a roentgenological curiosity. It may at times have a clinical importance which, slight as it may be because of its rarity, is none the less real. It is to be expected that the azygos lobe and the pleura about it are subject to the same diseases which affect the other lobes of the lung. We wish

Fig. 13. Chronic disease of the azygos lobe with induration.

to record two observations of clinical interest which will no doubt be supplemented by other observers as this anomaly becomes better known. The first case was a carcinoma of the lung with a complicating

pleural effusion which not only involved the general pleural cavity but also invaded the azygos fissure (Fig. 11). It was possible to note an increase in the size of this interlobar effusion on subsequent examination (Fig. 12). In the second case (Fig. 13) the azygos lobe was the seat of a dense irregular infiltration which was undoubtedly due to some chronic disease of the lobe. The nature of this process was not determined clinically as the patient had no symptoms which could be attributed to it. However, such a chronic disease of this lobe is not unknown, as a case has been described by Müller[5] in which the bronchus was narrowed by pressure of the azygos vein with a diffuse fibrosis of the lobe and multiple dilatations. In the case illustrated in Figure 8 which came to autopsy, the azygos lobe was atelectatic.

The azygos lobe is extremely rare. In our joint experience in the last fifteen years we have observed it in approximately 50 cases. It is probably more frequent than the roentgen examination would lead one to believe, because the small azygos lobes near the mediastinum may be obscured by the overlying lung and vena cava, and in other cases it is possible that the fissure itself may not be visible. Although its recognition is not a matter of clinical importance, it is a satisfaction to be able to adduce proof, by autopsy, of the nature of this shadow, which for so long has been a puzzle to roentgenologists.

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# SUBPLEURAL EMPHYSEMA AS A CAUSATIVE FACTOR IN THE FORMATION OF ANNULAR SHADOWS

BY HOWARD P. DOUB, M.D.

Department of Roentgenology, Henry Ford Hospital

DETROIT, MICHIGAN

DURING the past few years a number of writers have described the roentgen appearances of so-called annular shadows occurring over the pulmonary fields, as distinguished from those annular shadows representing true cavities in pulmonary tuberculosis.

These were first described by Sampson, Heise, and Brown[1] and by Evans[2] who believed that they were due to circumscribed pneumothoraces caused by lung rupture. In a comprehensive article, Amberson[3] has proven rather conclusively that many of these shadows are caused by simple subacute or chronic localized pleurisies which may or may not be associated with umbilication or puckering of the subjacent lung tissue and consequent localized separation of the pleural layers; the resulting interstice may contain freely movable fluid. Brown[4] believes that most of these shadows are due to cavities which may become obliterated much more quickly than was formerly believed. This assumption, however, apparently has been disproven by the accumulated literature. We believe that annular shadows occurring over the pulmonary field can also be caused by other conditions than those enumerated above. The type of shadows to be considered in this communication are those caused by emphysematous blebs and bullae.

In recent articles describing the study of the human pleura and its relation to emphysematous blebs and bullae, Miller[5] raises the question as to whether annular shadows may not sometimes be caused by

these blebs rather than by small pneumothoraces. Laurell[6] in a discussion on annular shadows in the lungs also raises the question as to whether some of these shadows may not be due to large interstitial emphysematous bubbles and possibly also to large emphysematous bubbles exposed to hypertension. He believes also that true tuberculous cavities may vary in size very rapidly due to the changes in the air pressure in the cavity in comparison with that prevailing in the surrounding tissues. Experimentally he has been able to produce large interstitial emphysematous bubbles by inflation of animals' lungs. He has also seen similar shadows in children's lungs and has been inclined to interpret them as interstitial emphysematous bubbles. Arnell[7] has recently reported the first authentic case of annular shadows caused by subpleural emphysema. These were seen in a man suffering from asthma whose lungs roentgenologically showed several annular shadows. At post-mortem examination the lungs showed evidence of emphysema, as well as some large subpleural emphysematous blebs, but no cavities or other signs of tuberculosis. Lentine[11] has also recently published a similar case which he terms a localized unruptured pneumothorax.

Excellent descriptions of blebs and bullae are given by Miller[3] who describes a bleb as a subpleural emphysema. These frequently occur on the mediastinal surface of the lower lobe although they may occur in the upper lobe. They are somewhat circular in outline and slightly elevated. They are caused by a rupture of some of the superficial pulmonary alveoli allowing the air to escape into the pleura separating this from the underlying lung. It therefore occupies a space outside of the lung itself. This has always been associated with a well-marked emphysema. After breaking through the surface of the lung it extends along the pleura separating this from the surface of the lung in a manner similar to that of a dissecting aneurysm extending along the wall of an artery. Bullae are found to be caused by a similar condition, that is, a pulmonary emphysema. Here the alveoli beneath the pleura are greatly distended and may even show destruction of the walls. Here, however, it is situated within the lung and is covered by an intact pleura. These are rather commonly seen at autopsy in cases of extensive pulmonary emphysema.

It is apparent, therefore, that these annular shadows have a different etiology from those which were first described. Hirakawa[5] has done experimental work on the elasticity and plasticity of the lungs by increasing the intrapulmonary pressure and by varying this from time to time. He found that by increasing the intrapulmonary pressure and continuing this for some time, the elasticity of the lungs was decreased but was reported normal after a considerable rest. If the increased pressure was continued over a long time the elasticity of the lungs was permanently lost. He believes, therefore, that this is a certain explanation of the etiology of emphysema and notes that this disease is often met with in patients with asthma, chronic bronchitis and others who suffer from chronic cough. He also noted that vocalists and Japanese diving women are very frequently affected by this disease. Wilson,[9] in a recent communication, reports a case of emphysema of the lung which was so extensive that it was diagnosed pneumothorax. The cause of this obstruction was not definitely determined but he suggests the possible cause as "a polypoid growth in one of the upper lobe bronchi or to pressure on such a bronchus by an enlarged bronchial lymph gland."

von Neergaard and Wirz[10] describe a method for testing the dynamic tension in the chest and have studied this tension in cases of asthma and emphysema. They believe that in these cases the normal easy flow of air in inspiration and expiration is somewhat interfered with. The greatest interference in this appears to be in expiration. Several cases in our series had rather large malignant growths in the region of the main bronchus of the affected lung. It is possible that this may have had considerable influence in raising the intrapulmonary pressure, thus contributing to the causation of the emphysema. Laurell,[6] as mentioned above, has also been able to produce this condition experimentally in animals by increasing the tension in the lungs.

Fig. 1. Case 1. Pneumonia of right base. Many large and small air sacs throughout the right base. Several large sacs are shown in the left base back of the shadow of the left ventricle.

On the roentgenogram these shadows are seen as rounded or irregular shaped areas of decreased density with a rather thin dense linear outline. Most of these shadows occur in or near the base of the lung although they may also be seen in the upper portion of the chest. They do not ordinarily show the characteristics of a true cavity and in addition are frequently not associated with pulmonary tuberculosis. The lung may be so filled with these smaller and larger rounded and irregular shaped shadows that it may suggest a honeycombing of the lung (Fig. 6) and at post mortem the lung will show a structure which corresponds in its gross appearance (Fig. 7) very closely with the roentgenogram. In addition, the picture of generalized pulmonary emphysema is seen in most of these cases. Occasionally when these annular shadows lie just above the left diaphragm, they may lead one to suspect that he is dealing with diaphragmatic hernia, with portions of the hollow viscera in the chest cavity. This, however, can easily be ruled out by outlining the gastrointestinal tract by means of barium.

## CASE REPORTS

Case 1. No. 66101. C. J. A., male, aged twenty-eight.

The patient developed a sharp right-sided pain referred to the diaphragm following a game of basket ball two weeks previous to admission. This cleared up and he felt well until two days ago. A second attack also followed a basket ball game. This attack began with a chill and severe pain at the right costal margin. This pain was increased by deep breathing.

*Physical Examination.* Temperature 100.6°; pulse 102; respiration 24; W.B.C. 18,300. There is evidence of pneumonic changes in the right base with limitation in movement of the diaphragm.

*Roentgen-ray Examination.* A film of the chest on admission (Fig. 1) showed an area of pneumonia in the right base, together with a large number of rounded shadows of decreased density so that the lung appeared to be honeycombed. There were also several larger annular-like shadows seen in the left base. The stomach and colon were then filled with barium to exclude the possibility of diaphragmatic hernia. The following day the pneumonic consolidation in the right base had spread up to the upper lobe (Fig. 2). The same ring-like shadows were seen. Two days following this there was evidence of pneumonia of both bases and the ring-like shadows on the left side had become more evident.

The patient died on the fourth day following admission. A post-mortem film (Fig. 3) showed extensive pneumonia of both lungs with a honeycombed appearance of the right base and a number of very large gas-filled annular shadows over the left base.

*Post-mortem Findings.* The abdominal cavity showed nothing of interest.

Thoracic Cavity. The pleural cavities were both almost entirely obliterated by firm fibrous adhesions. There was no free fluid. The heart was negative.

Lungs. There were many thin, elastic, superficial, air sacs present, especially at the base of the right lower lobe. On section these collapsed with the escape of gas. The walls were smooth and glistening. The middle and lower lobes were almost completely consolidated. In the left lung nodular masses could be felt in the substance of both lobes. On section these masses contained turbid fluid and gas. The lining in each case was smooth and glistening. They did not communicate with the larger bronchi nor with the pleural surface of the lung. There was also consolidation of a considerable portion of this lung. Anatomical diagnosis in regard to the chest: (1) Chronic, obliterative, fibrous bilateral pleuritis; (2) marginal bullous and paren-

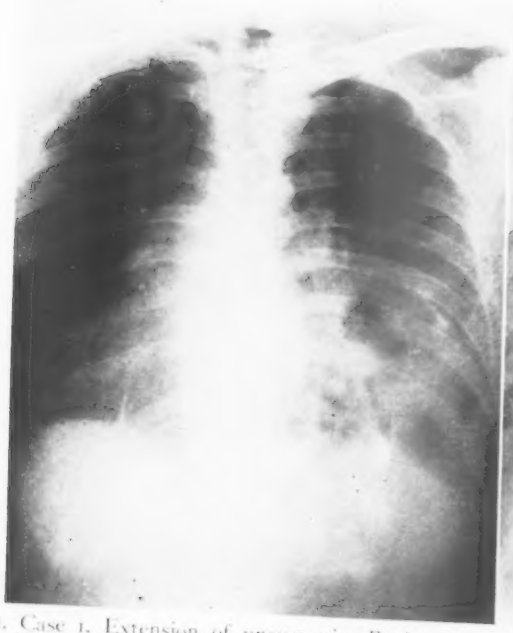

FIG. 2. Case 1. Extension of pneumonia. Barium in cardia showing stomach below the diaphragm.

FIG. 3. Case 1. Post-mortem film. This shows marked extension of the pneumonia and also very large sacs filled with gas.

chymatous bilateral emphysema; (3) lobar pneumonia of the right middle and both lower lobes, and (4) lobular pneumonia of the left upper lobe.

CASE II. No. 60833. W. A. S., male, aged sixty-two.

*Complaint.* Asthma. Loss of weight and shortness of breath.

*Physical Examination.* The chest findings revealed evidence of chronic bronchitis, asthma and emphysema. There was some widening of the mediastinum.

*Roentgen-ray Examination.* Films of the chest revealed marked widening of the mediastinum with a large discrete new-growth in the region of the left hilus. There was also evidence of emphysema in both bases with several annular shadows in the left base (Fig. 4). There was also evidence of old thickened diaphragmatic pleura.

No primary tumor could be found to account for the mediastinal growth. The tumor temporarily regressed under the influence of deep roentgen-ray therapy but finally recurred and the patient continued to lose ground. Death occurred about three months following the first admission.

*Post-mortem Findings.* Abdominal Cavity. There was a tumor involving the pancreas and nearby lymph nodes. There was also about 2000 c.c. of fluid in the peritoneal cavity. The other abdominal organs showed no pathology.

Thorax. There was a small amount of fluid in the base of both pleural cavities. In the anterior mediastinum there were large, firm, lobulated nodules. The larger nodule was on the left side, with smaller ones on the right side.

FIG. 4. Case II. This shows tumor nodules around both hilus areas and in the upper mediastinum. There is also a large air sac seen just above the left diaphragm and lateral to the cardiac shadow.

Fig. 5. Case II. Photograph of lung showing bleb on inferior surface and tumor nodules around hilus.

two lobes. The remainder of the lung was apparently air containing. Attached to the lower edge of the lower lobe and situated between the inferior surface of the lower lobe and diaphragm there was a somewhat flattened, thin-walled, hen egg sized, multilocular vesicle filled with air (Fig. 5). The other findings in the examination are not of importance in this study.

Diagnosis. Primary carcinoma of the pancreas with metastases to the regional and bronchial lymph nodes; metastatic carcinoma of the left lung; pleural effusion; bullous emphysema; hydroperitoneum.

Case III. No. 53432. J. B. M., male, aged seventy-three.

*Complaint.* The patient was admitted complaining of a pain in the heart, difficulty in breathing and asthma.

Examination of the patient revealed a chronic myocarditis with rather evident insufficiency. There was also chronic nephritis and emphysema. The patient was in very bad condition and declined rapidly, dying within thirty-six hours of admission.

*Post-mortem Findings (Chest).* The pleura showed many fibrous adhesions. The right

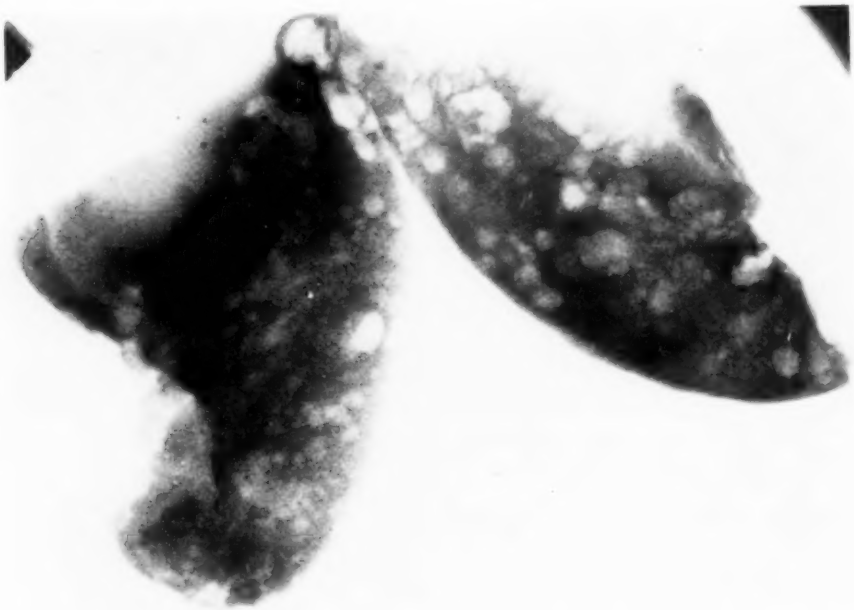

Fig. 6. Case III. Roentgenogram of a section of lung about 1 inch in thickness. This shows many air sacs o varying sizes throughout the lung, demonstrating vesicular emphysema.

The right lung was voluminous and some of the bronchial lymph nodes were transformed into tumor nodules. The left lung was somewhat smaller with a firm nodule at the junction of the upper lobe showed dilatation of the alveoli. In the middle lobe the dilatation was more pronounced, while in the lower lobe the parenchyma had a honeycombed appearance

FIG. 7. Case III. Photograph of cut section of lung as shown in Figure 6.

and was transformed into irregular thin-walled spaces of varying sizes. The left upper lobe was rather firm. The lower lobe was reddish brown and was firm also. The same honeycombed appearance could be seen in the lower lobe on this side. The bronchi of both lungs discharged much purulent material when compressed (Figs. 6 and -). A diagnosis was made of chronic emphysema of the right middle and both lower lobes and acute exudative bronchitis and edema of the lungs.

Because of the patient's condition this case was not roentgenographed.

CASE IV. No. 31632. R. T., male, aged sixty-four. The patient complained of a swelling in the right side of the neck and axilla which began fifteen months ago, also shortness of breath for the past five years. Examination of the chest revealed an emphysematous type of chest with diminished breath sounds and dullness, especially in the right base. Enlargement of the supraclavicular and axillary glands on the right side were found.

One of the supraclavicular glands was removed for biopsy. A diagnosis of Hodgkin's disease was made from the microscopical study.

*Roentgen-ray examination* of the chest revealed evidence of tumor formation around the right hilus and running toward the right base. There was also evidence of marked peribronchial fibrosis with some scattered changes suggesting pneumoconiosis. Several annular-like shadows were also seen in the right base (Fig. 8).

This is a case of tumor formation occurring at the root of the lung, together with evidence of emphysema and accompanying annular shadows. This case is not confirmed by post-mortem examination.

FIG. 8. Case IV. Hodgkin's disease of the lungs. There are also several air sacs in the right base lateral to the right margin of the heart.

FIG. 9. Case V. This shows a number of fairly large air sacs in both bases.

CASE V. No. 92557. T. D., male, aged sixty-three. The patient claims that he has been gradually declining since an attack of influenza in 1918.

*Physical Examination.* The chest was barrel

shaped and nearly immobile. The breath sounds were prolonged but no râles were heard. The other findings are not significant in this study.

*Roentgen-ray examination* of the chest at this time revealed marked evidence of peribronchial fibrosis throughout the lungs. There was also generalized emphysema throughout both lung fields. In the left base there were numerous large, rounded, clear, areas suggesting emphysematous air sacs. There were also several similar shadows in the right base (Fig. 9).

The striking features of this case are the marked emphysema with associated subpleural emphysematous blebs.

## DISCUSSION

We have here, then, a condition which produces annular or irregular shaped shadows on the roentgenogram which can be differentiated from tuberculous cavities. They commonly occur in or near the bases of the lungs and frequently occur in the incisura between the lobes and on the mediastinal margin. Miller[5] has given a masterly gross and microscopic description of blebs and bullae together with their differential diagnosis. He has raised the question of whether some of these annular shadows in the roentgenogram may not represent emphysematous blebs. This we believe has been confirmed by the case reports given above together with the cases reported by Arnell,[7] and Lentine.[11]

They have usually been observed in cases of extensive emphysema. From literature quoted it would seem quite likely that any condition causing an increase in the intrapulmonary tension may be a contributory factor in causing this condition. Three of the cases reported above had large malignant growths in the region of the main bronchi of the affected lungs. While this may be a coincidence, it should be credited as an etiological factor until the etiology is more completely determined. Lungs which are the seat of tuberculosis are especially likely to show emphysematous blebs as shown by Miller,[5] so that the diagnosis of these as simple emphysematous blebs in contradistinction to tuberculous cavities becomes a very serious problem. This has been discussed in the previous literature on annular shadows.

The diagnosis of these annular shadows should be relatively easy roentgenologically if they are observed in the presence of pulmonary emphysema. We believe they can usually be differentiated from true cavities in pulmonary tuberculosis.

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# AN UNUSUAL FRACTURE OF THE ALVEOLAR PROCESS OF THE SUPERIOR MAXILLA WITH DISPLACEMENT OF THE RIGHT CENTRAL INCISOR*

## CASE REPORT

BY PERCY D. HAY, JR., M.D.

PHILADELPHIA, PENNSYLVANIA

FRACTURES of the superior maxilla are relatively infrequent, the incidence in our series being only 21 in a total of 10,339 fractures.

### CASE REPORT

S. W., a male, aged twenty, was admitted to the service of Dr. George P. Muller, University Hospital, complaining of a laceration of the upper and lower lips.

*History Present Illness.* While working on a scaffold, the patient lost his balance and fell for a distance of about 7 ft., striking his chin and lips on a steel girder during his descent. The patient landed on his feet and never lost consciousness. Additional history is irrelevant.

*Physical Examination.* The patient was a young adult male walking around the ward.

*Head, Eyes and Ears.* Negative.

*Nose.* The ala of the right nostril was widely dilated and in it could be felt the right central incisor which lay just below the floor of the nose. There was considerable swelling of the soft tissues and some coagulated blood which prevented nasal breathing on the right side.

*Mouth.* The right upper central incisor was missing from its socket in the alveolar process of the superior maxilla. The mucous membrane was lacerated in that region.

The lower lip was slightly lacerated, otherwise the examination was negative.

*Roentgenological Examination.* Two views were made, and the report was a comminuted fracture of the alveolar process of the right superior maxilla with upward displacement of the right central incisor.

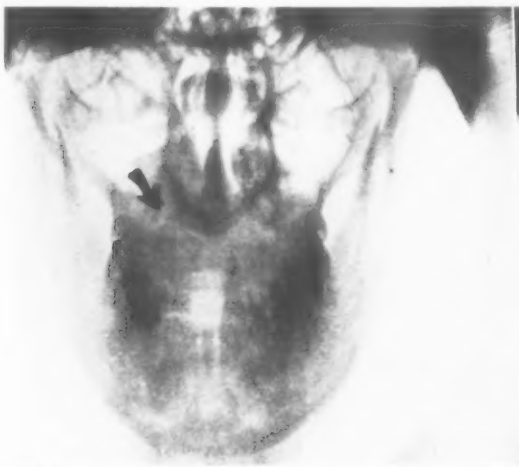

FIG. 1*a*. Film in the maxillary sinus position, that is, with the chin and nose on the cassette, the cassette being placed on an inclined plane of 23°, which shows the absence of the right central incisor in its normal position; the incisor can be faintly seen in the soft tissues just below the floor of the right nasal chamber indicated by the arrow.

FIG. 1*b*. Lateral view shows the soft tissues of the face and nose. One can see the displaced tooth and the small comminuted fragments of the anterior plate of the alveolus attached to it.

Small films of the injured region made from the inside of the mouth did not give any additional information.

The patient was then sent to the surgical clinic and the tooth easily removed and the mucous membrane sutured. The patient made an uneventful recovery.

*Comment.* The case is reported because of its unusual type. The trauma responsible for the injury is of course very infrequent and easily affords an explanation why such fractures are not seen more often (see Figs. 1*a* and 1*b*).

* From the Department of Roentgenology, University of Pennsylvania.

# THE ROENTGENOLOGIC DEMONSTRATION OF NON-UNION IN THE FEMORAL NECK*

BY P. M. HICKEY, M.D.

ANN ARBOR, MICHIGAN

ONE of the interesting phases of roentgen-ray work is the assistance it renders in a study of some of the problems constantly presented to the orthopedic surgeon. The roentgenologist is frequently asked whether union has taken place in a fracture of the femoral neck. In a fracture of one of the long bones, especially where the break has occurred in the middle third, the ordinary clinical methods of investigation are usually sufficient to determine whether or not union has taken place.

In fracture of the hip, after the patient has been under treatment for some weeks, it is often very important to decide as to whether union has occurred. These questions often present themselves and upon their correct solution depends the future treatment of the case. It is obvious that in fractures of the hip the usual clinical methods of examination in demonstrating union in a fractured hip have their shortcomings. Frequently manipulation will not decide as to whether abduction takes place with only motion of the femoral head within the capsule, or if there is still mobility at the site of the solution of continuity.

Roentgenoscopic observation during manipulation is usually indecisive in fractures of the femoral neck because the thick covering of the soft parts prevents a clear differentiation of the bony parts; first, because of the scattered radiation and second, because the mobility is often so slight that it cannot be demonstrated by the roentgenoscope.

In the study of the fractured hip, the usual stereoscopic anteroposterior projection will demonstrate the position of the fragments and line of apposition. However, as the demonstration of callus is ausully infrequent in these cases, it is evident that the stereoscopic method will be indecisive as to whether a firm union has taken place. Therefore, in cases where treatment has been carried out according to classic methods for a period of several weeks and the surgeon is anxious to learn if the fragments are united, the following procedure was tried. In such a case three films are taken; the first one with the hip and femur in the usual standard position and the femur parallel to the long axis of the body; the second film is made with the femur in extreme abduction while the pelvis is immobilized as far as possible; the third film is made with the hip and femur in extreme adduction, the pelvis being held as far as possible in the first standard position. Through this procedure it has been found that where the head and neck retain the same relative position in the three positions, there is positive roentgenographic evidence that union has taken place. If, on the contrary, there is a change in the relative position of the femoral head and neck when adduction is compared with abduction, the roentgenographic evidence is decisive that union has not taken place.

It is very evident that the above described procedure is not recommended in the earlier stages of a fractured hip. It is suggested in the examination of cases where traumatism has occurred a number of weeks before and where it is reasonable to suppose that sufficient time has elapsed for the parts to have become united. During the early stages of a fracture of the hip it is self-evident that damage will be done if abduction and adduction are instituted. Even at the risk of repetition, it is a method which is not recommended for recent fractures whether impacted or not. It is a procedure which is suggested not for the study of the type of treatment to be instituted early in the history of the case, but a study which is of value in determining the result of treatment. It is helpful in deciding whether operative treatment is necessary after the usual classic methods of treatment have been tried for an appropriate length of time.

* Read at the Twenty-eighth Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Montreal, Canada, Sept. 20–23, 1927.

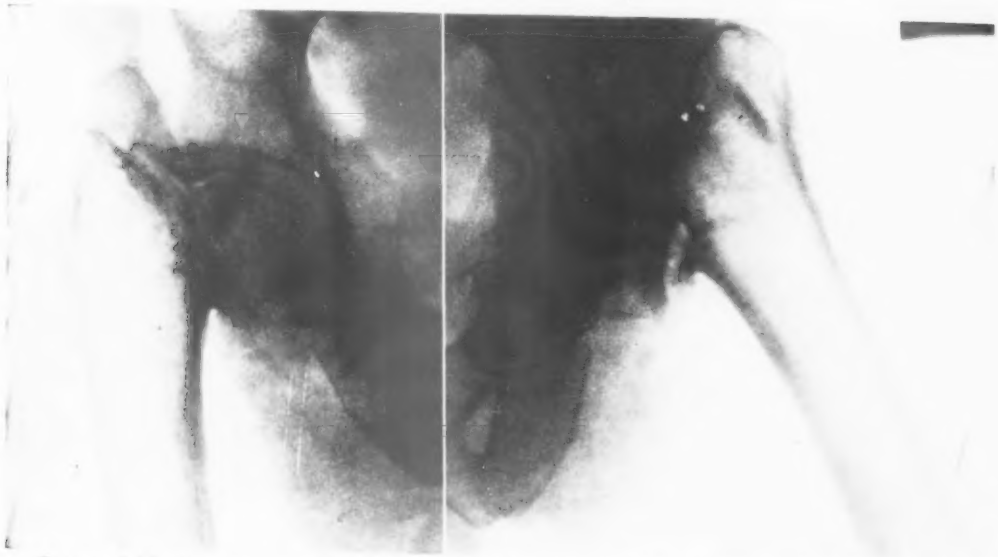

Fig. 1. Case I. Adduction contrasted with abduction demonstrating the change in the angle of the shaft with the femoral head, confirming the diagnosis of non-union.

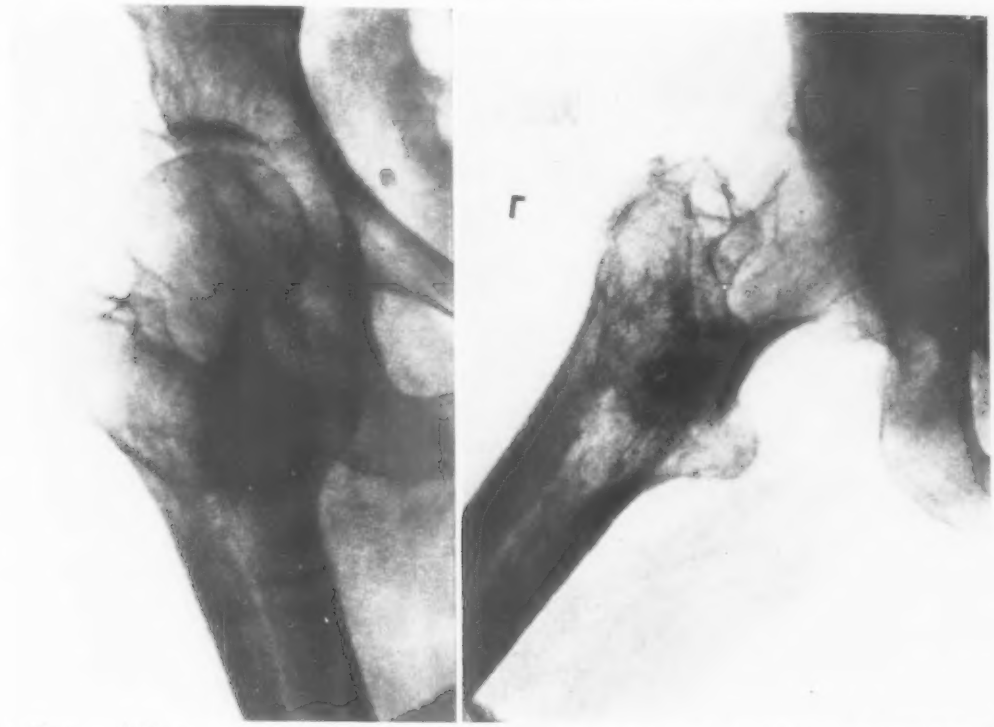

Fig. 2. Case II. Adduction contrasted with abduction showing no change in the relation of the shaft with the femoral head, demonstrating firm union.

The following cases illustrate the application of this method:

### CASE REPORTS

Case I. W. J. C., aged fifty-nine. Admitted to hospital Feb. 11, 1927. Patient suffered a fracture of the left hip two years ago and an open reduction was attempted at that time. On examination the left leg was seen to be held in adduction and external rotation. Films were made in adduction and abduction which show a fixed position of the head and a definite

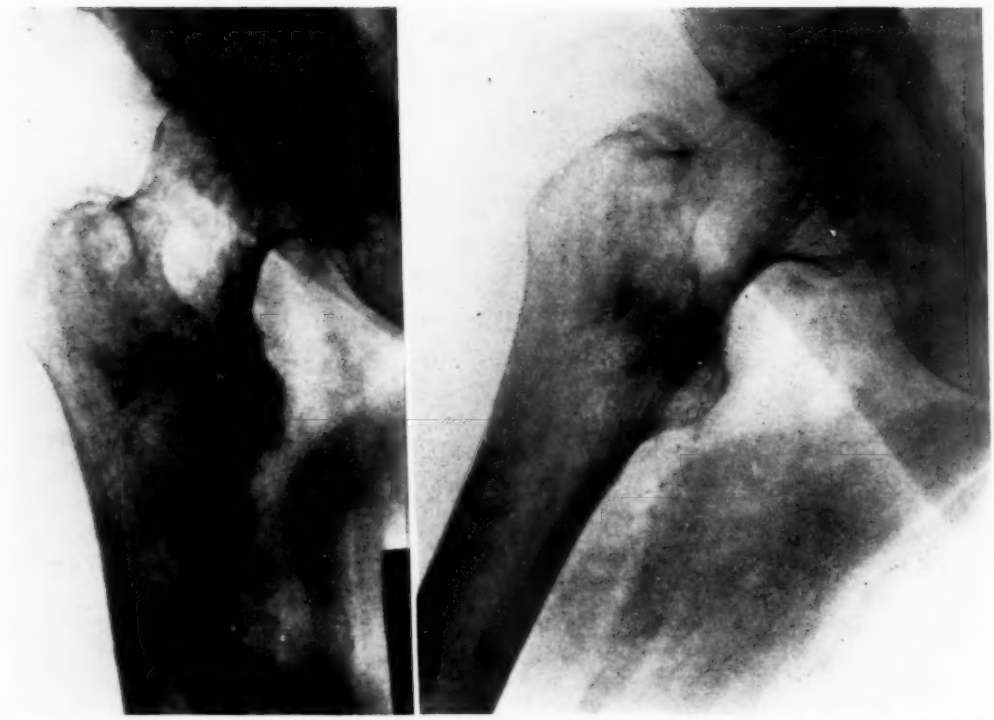

FIG. 3. Case III. Comparison of films in adduction and abduction confirm the clinical findings of firm bony union.

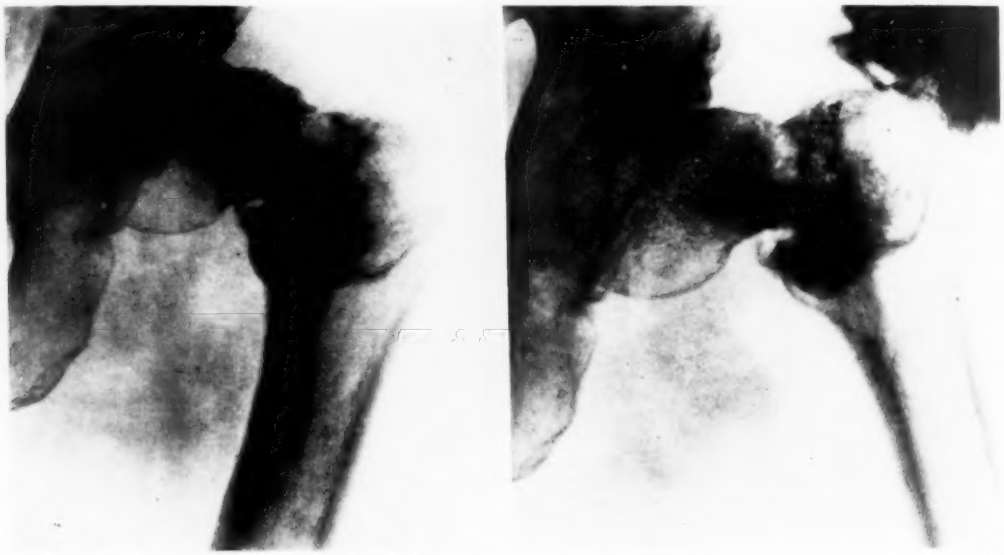

FIG. 4. Case V. The change in the angle of the head and neck when abduction is compared with adduction establishes the diagnosis of non-union.

change in the angle of the shaft with the head; evidence therefore of non-union.

CASE II. M. U., aged thirty-nine. Admitted to hospital Nov. 13, 1926. At this time the patient was in a disturbed mental condition for which she was admitted. The day after entering she fell and injured the left hip. Examination at that time showed an inter-trochanteric fracture of the left femur. She was treated by manipulation and cast, and six months later re-examination was made with the femur in adduction and abduction, which showed no

change in the relationship of the head and neck and shaft in the two positions. The conclusion, therefore, was that firm bony union had taken place.

Case III. L. D., aged seventy. Admitted to hospital April 29, 1927, with a history of a fall on the right hip on the previous day. Roentgen-ray examination at the time of admission showed an inter-trochanteric fracture of the right femur. She was treated by manipulation and application of cast. Three months later, films made in extreme abduction and extreme adduction showed no change in the relative position of the neck and shaft of the femur. This was accepted as evidence of bony union.

Case IV. S. F., aged sixty-five. Admitted to the hospital March 10, 1927. She had sustained a fall two months previous. Roentgen-ray examination at the time of entrance showed a fracture of the neck of the left femur. She was treated by manipulation, abduction, and application of cast. Four months after treatment was instituted, the films made in abduction and adduction showed a marked difference in the relative position of the head and neck in the two positions. This was taken as definite evidence of non-union.

Case V. A. D., aged forty-two. Admitted to the hospital July 11, 1927, with history of a fall one year previous, followed by a loss of weight bearing of the left leg. Films were made in extreme abduction and extreme adduction which show a very definite change in the angle of the head and neck with the shaft of the femur. This was taken as definite evidence of non-union.

Case VI. A. F., aged fifty. Admitted June 8, 1926. Roentgen-ray examination at that time showed a comminuted fracture of the neck of the left femur treated by Steinman pin traction. Two months later, examination in the two positions of abduction and adduction showed no change in the angle. This was regarded as evidence of union in the neck of the femur.

Another question which confronts the bone and joint surgeon is how long immobilization is necessary in the after treatment following a Hibbs operation; here the same principle of two films with movement of the upper spine and lower pelvis in opposite directions gives evidence as to the presence or absence of union. This is illustrated by the following case:

Case VII. A. A., aged thirty-seven. Admitted to hospital for Pott's disease. Roentgen-ray examination showed involvement of the 8th and 9th dorsal vertebrae with destruction of the intervertebral discs as well as the corresponding bodies. After the Hibbs operation was performed and six months later, two films were made with the lower thoracic region immobilized by sand bags while extreme displacement of the upper thoracic and pelvic areas was attempted. The two films which were made show no displacement of the area operated upon. This was taken as roentgen-ray evidence of union between the articulating facettes in the area operated upon.

## CONCLUSIONS

This paper is presented to bring out the fact that the results of treatment of fracture of the neck of the femur can be studied by films made in extreme adduction and abduction, demonstrating the presence or absence of bony union.

# GIANT CELL TUMOR OF THE SPINE

## WITH REPORT OF A CASE*

BY ALBERTUS COTTON, M.D.

Mercy Hospital

BALTIMORE, MARYLAND

GIANT cell tumor of bone is the name adopted by the American Society of Clinical Pathologists and the American College of Surgeons for the tumor formerly known as giant cell sarcoma. This tumor is essentially benign in character. It may recur locally after removal but does not invade and destroy tissue, metastasize or cause death. It has been found in most of the bones of the skeleton—long, flat, irregular and short bones. It occurs most frequently in the ends of the long bones, especially the lower end of the femur, upper end of the tibia, lower end of the radius and lower jaw. In a small number of cases, about 3 per cent of the cases of the Registry of Bone Sarcoma of the American College of Surgeons the tumor was located in the vertebrae.

The following is a report of a case of giant cell tumor of the spine:

### CASE REPORT

R. G., male, aged fifteen.

Family and previous history negative.

History of Present Condition. Two injuries—fall on the buttock in October, 1924; disabled only a few days; two months later began to have pain in the lower back and left hip. Second injury in February, 1925—a wrench of the back; confined to house and treated by osteopath; put to bed in March, 1925, and remained there until admitted to the hospital the following October.

Physical Examination. Patient brought to the hospital on a stretcher, wearing a body plaster jacket; lay on back with left thigh flexed 45°, knee flexed to 90° and foot extended; unable to sit up or turn in bed.

General Condition. Patient was anemic and thin. Blood examination: hemoglobin 70 per cent; red cell count, 4,000,000; no leucocytosis nor septic factor; temperature normal.

Examination of spine after removal of cast. The back was very stiff and painful; motions of lumbar spine limited in all directions; large kyphus over fourth and fifth lumbar and first portion of sacrum with hollow back in dorsi-lumbar region and compensatory straightening of dorsal spine. Definite scoliosis convex to the left in lumbar, to the right in dorsal region. Fluctuating swelling the size of a grapefruit to the left of spines of fourth and fifth lumbar and upper sacral vertebrae. Left hip—flexion deformity of 45° with loss of extension (psoas contraction); all other motions normal. Right hip—normal. Right knee, ankle and foot—normal. Left knee—flexed to 90° with definite contracture of hamstrings (postural deformity); otherwise normal. Left ankle and foot—foot drop with foot in position of equinus with some varus due to complete paralysis of anterior tibial muscle group (extensors and peroneals) and shortening of tendo Achillis. Sensation—anesthesia along distribution of external popliteal nerve. Reflexes—(knee) right normal, left absent.

Roentgen-Ray Findings. Bone destruction of left side of body, transverse process, lamina and pedicle of fifth lumbar, left ala of sacrum extending into sacroiliac joint; anterior surfaces of bodies of fifth lumbar and sacrum not involved. Marked bone atrophy. No bone production. Definite partial spondylolisthesis of fifth lumbar. Intervertebral discs not destroyed.

Preoperative Diagnosis. Lumbosacral Pott's disease with lumbar abscess.

Treatment and Subsequent Course. Exploratory operation over fluctuating swelling to left side of fourth and fifth lumbar spines. Incision through the erector spinae muscle into a cavity the size of a large orange containing old blood, friable granulation tissue and loose pieces of bone. There was free venous and capillary bleeding into the cavity. Definite erosion on left side of body pedicle and lamina of fifth lumbar and upper end of sacrum was found. No purulent fluid was present nor other signs of a tuberculous abscess. Several loose pieces of bone and some of the friable tissue were removed for examination. The spinal canal was not explored. Wound was closed in layers, so far as possible, with cigarette drain in lower corner.

Operative Diagnosis. Sarcoma or benign giant cell tumor of spine. The old blood with friable granulation tissue and absence of

* Read at the Twenty-eighth Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Montreal, Canada, Sept. 20–23, 1927.

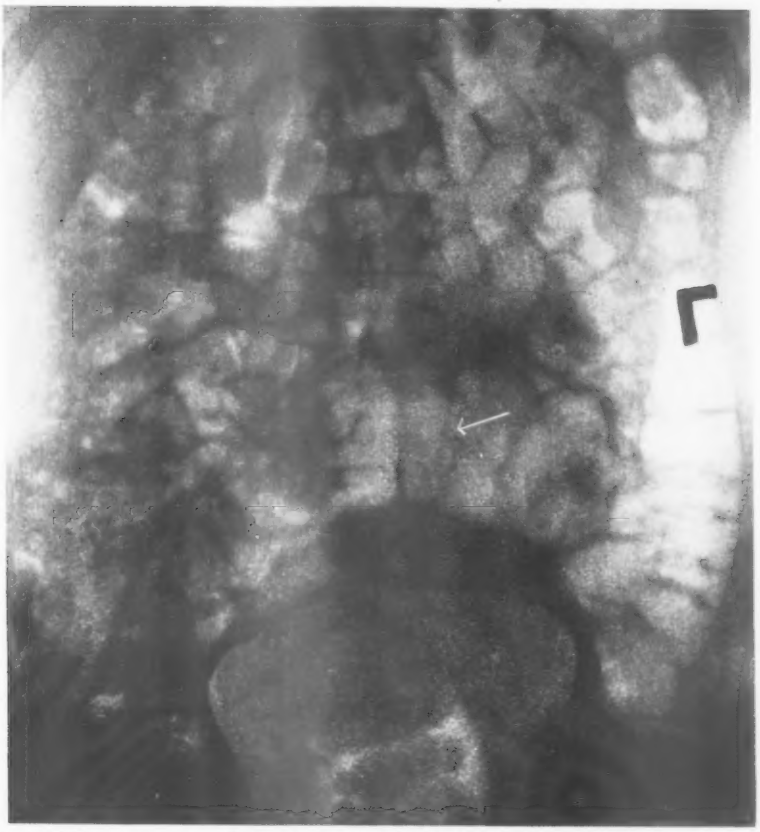

FIG. 1. Oct. 9, 1925. Before operation. Spondylolisthesis fifth lumbar; bone atrophy. Detail obscured by bone atrophy and gas in intestine. Anteroposterior view.

characteristic sarcoma tissue were suggestive of giant cell tumor. Wound healed without infection in about three weeks.

Pathological Report. The report of the pathologist, Dr. Standish McCleary, was myeloid or benign giant cell tumor of bone. There was bone resorption but no infiltration by tumor.

Subsequent Treatment.

(1) Constitutional—general building up treatment, nourishing food, fresh air, sunshine with iron tonics.

(2) Rest on back in fracture bed.

(3) Roentgen-ray treatment was begun at once, using 9 in. tube with 6 mm. of aluminum, giving suberythema doses through three portals of entry—back and both sides. Four series of treatments were given altogether with intervals of four to five weeks.

(4) The deformities of left hip, knee, ankle and foot were corrected by extension, followed by manipulation under anesthesia and casts. Later a removable plaster body jacket was applied and an ankle brace was provided on account of foot drop of left foot and ankle.

Result. It is now nearly two years since the

FIG. 2. Same as Figure 1. Lateral view.

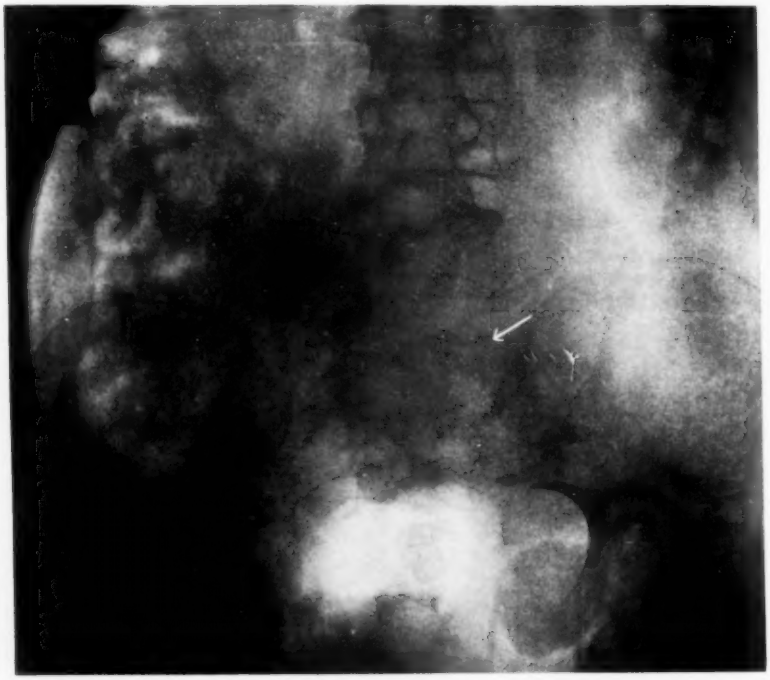

FIG. 3. Jan. 12, 1926. Bone destruction of fifth lumbar, lamina and pedicle, and of sacrum, left side; bone atrophy.

FIG. 4. Aug. 3, 1926. New bone formation below the fifth lumbar and anterior to the spondylolisthesis; healed condition.

operation and over two and a half years since the tumor began.

The patient has discarded his plaster jacket, wears a left ankle brace and uses a cane. His general condition is good. He has gained in weight and is not anemic. He has considerable deformity of spine—kyphoscoliotic type. The tumor has disappeared and the operative scar healed. There is free motion in the upper dorsi-lumbar region, but the lumbosacral spine is quite stiff. He has a left foot drop, requiring an ankle brace, due to paralysis of extensors of toes and weakness of peronei. There is decreased sensation over outer surface of left leg and dorsal surface of foot. There is marked atrophy of left thigh and leg.

Roentgen-ray Examination. This shows the area of bone destruction on left side of body lamina and pedicle of fifth lumbar and left upper end of sacrum filled in with new bone formation—a healed condition. The spondylolisthesis is still present. The patient has returned to school and is apparently well.

Lewis,[1] in 1924, reported one of his own cases of giant cell tumor of the spine with 16 from the literature. In none of these cases were there metastases. There were local

[1] Lewis, D. Primary giant cell tumors of vertebrae. *J. Am. M. Ass.*, 1924, lxxxiii, 1224–1229.

FIG. 5. Aug. 3, 1926. New bone formation left side, upper end of sacrum and about pedicle of fifth lumbar; bone atrophy much less marked; healed process.

recurrences in some cases. Cure takes place by ossification of the diseased bone. In practically all of these cases the histology was that of a giant cell tumor. In some cases the growth resembled a chronic resorptive process with excessive formation of granulation tissue. Because of the frequency of this pathology, Barrie called the condition chronic hemorrhagic osteomyelitis.

As practicing physicians and surgeons, our chief interest in these rare tumors of the spinal column is in the diagnosis and treatment. If the diagnosis is made before irreparable damage is done to the spinal cord or cauda equina and the proper operative treatment is carried out, the patients get well. If the tumor is not recognized or is allowed to pursue its course unchecked, structural damage will be produced in the spinal cord or cauda which will cause permanent paralysis.

The diagnosis is not easily made as shown in the case reported above. The signs and symptoms produced are those that naturally follow a destructive lesion which interferes with functions of the spine—viz., pain, weakness, limitation of motion; abnormal attitude or gait, deformity, motor or sensory disturbances or paralysis. These signs and symptoms may also be produced by Pott's disease, metastatic carcinoma, malignant sarcoma, lues (Charcot's spine), osteomalacia, multiple myeloma, compression fracture of the bodies of the vertebrae, erosions from aortic aneurysm, actinomycosis and blastomycosis. Any one of these conditions may interfere with the functions of the spine in a similar way. However, a careful consideration of the history of the case, including probable antecedent trauma, the age of the patient, usually the second or third decade; the signs and symptoms, especially pain which may or may not be radiating, together with the roentgen-ray findings

Fig. 6. March 9, 1928. Same pathology as Figure 3; also some new bone formation; less bone atrophy.

Fig. 7. March 9, 1928. Same as Figure 6. Lateral view.

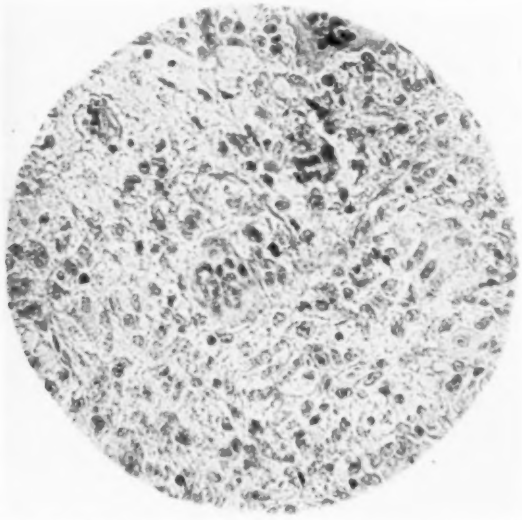

Fig. 8. Photomicrograph of tumor showing giant cells of epulis type.

should lead one to a tentative diagnosis. The roentgen findings are especially important. The bone destruction is not confined to the anterior portion of the vertebral bodies and intervertebral cartilages, as in Pott's disease, but may involve the lateral or posterior surfaces, laminae, pedicles or any of the vertebral processes. There is no bone production until the healing process begins. There will be absence of some of the characteristic signs of the other

diseases in question—e.g., no psoas abscess as in Pott's disease; a negative Wassermann reaction and no associated signs of lues; no primary carcinoma; no lesion in the other bones as in multiple myeloma; none of the associated lesions of actinomycosis or blastomycosis. Malignant osteogenic sarcoma of the spine offers the greatest difficulty in diagnosis. The signs, symptoms and roentgen-ray findings may be very similar. Exploratory operation and examination of the gross pathology together with frozen sections at the time of operation are often necessary. The dark reddish, friable, granulation-like tissue compared to liver-pudding, with more or less free bleeding is quite typical of giant cell tumor. If the frozen sections show the very characteristic picture of loosely arranged spindle cells around vessels and capillaries with numerous giant cells of epulis type, the diagnosis is no longer in doubt. While giant cells are found in osteogenic and other malignant sarcomata of the long bones, they are not of the epulis type and such tumors do not show the characteristic roentgen-ray appearance of giant cell tumor.

It is well to remember that the frozen sections do not always show the tumor cells—sometimes only granulation tissue and the process of repair. If the gross pathology is characteristic, the absence of tumor cells in the frozen section means that tumor tissue has been missed in the sections and will be found later in the laboratory specimen.

When the diagnosis of giant cell tumor of the spine has been made, the indications for treatment are quite definite and if the spinal cord or cauda equina has not been damaged, we can give the patient a good prognosis.

The treatment will vary according to the stage of the disease. If recognized early by aid of the history, symptoms and roentgen ray findings and there is no pressure, we would be justified in trying roentgen therapy. It has been shown repeatedly that the use of filtered hard roentgen rays in giant cell tumor of the long bones will stimulate bone production and healing of the disease. In most cases, however, when the patient is brought to our attention, there is either a tumor mass in the back near the involved vertebrae or definite evidence of spinal cord or cauda equina pressure from a destructive lesion of the vertebrae.

We are often unable to make a definite diagnosis from the history, clinical and roentgen-ray data. In such cases a careful exploratory operation is indicated either through the tumor mass or in the absence of a tumor through the laminae of the vertebrae shown by the roentgenograms to be the seat of the disease. As much of the tumor mass and loose bone as is feasible should be removed. If the spinal cord or cauda is exposed it should be relieved of pressure without opening the dura. The wound should be closed in layers, draining when indicated and taking great care to prevent infection. After healing of the operative wound, several series of filtered roentgen radiation should be administered by the cross-fire method. If the patient has deformities of the hips, knees, ankles or feet due to paralysis or malposition in bed, they should be corrected by appropriate orthopedic treatment. The correction should be maintained by suitable braces and physiotherapy measures should be used in the after treatment.

With this treatment a cure of the lesion, assuming it to be a giant cell tumor of the epulis type, can be assured. Recurrences may take place but they can be controlled by secondary operation or roentgen-ray therapy. The recovery of function depends upon the damage done to the cord or cauda. If there has been destruction of nerve cells or fibers with sclerosis in cord or nerves, there will be a permanent paralysis of muscles controlled by cord or nerves involved. If there has been pressure only without degeneration there should be recovery of function.

SUMMARY

1. Giant cell tumor of bone of the epulis type is essentially a benign lesion and can be cured by appropriate treatment.

2. It occurs most frequently in the second or third decade but may occur in younger or older patients.

3. There is evidence of previous injury in a large proportion of cases.

4. The gross and microscopic pathology is very characteristic.

5. The roentgen-ray findings while not pathognomic are one of our most valuable aids in diagnosis.

6. Giant cell tumor of the spine is rare as compared with the same lesion in the ends of the long bones and the jaws—not over 3 per cent of cases.

7. The diagnosis may be difficult and require the aid of the history, clinical, laboratory and roentgen-ray findings together with exploratory operation and examination of the gross and microscopic tissues.

8. A differential diagnosis from the other destructive lesions of the spinal column is important because of the difference in prognosis and methods of treatment.

9. The prognosis of giant cell tumor of the spine is good with appropriate treatment. Cure is accomplished by bone production in the diseased area.

10. The treatment is exploratory—operative removal of tumor tissue and loose bone and relief of pressure on the spinal cord or cauda equina. Postoperative roentgen irradiation is beneficial.

11. Recovery of function of paralyzed muscles depends upon the extent of damage to the cord or nerves of the cauda equina.

# DUODENAL DIVERTICULUM

## DISCUSSION OF ROENTGEN-RAY FINDINGS AND REPORT OF TWO CASES

BY MEYER GOLOB, M.D.

Attending Gastro-Enterologist, Vanderbilt Clinic, Columbia University

NEW YORK CITY

UNTIL recent years diverticulum of the duodenum was believed to be a very rare condition. Morgagni[1] in 1761 gave the first clear pathologic description of this condition. Baldwin[2] in 1911 reported 67 cases collected from the literature, to which he added 15 of his own.

Since the practice of examining the gastrointestinal tract roentgenologically for minor digestive complaints has become common, it is now recognized that duodenal diverticula are not so rare as was formerly supposed. Case[3] in 1920 reported finding 85 cases in a total of 6,847 barium meal examinations. Andrews[4] reviewed the roentgenologic findings in a series of about 2,220 stomach patients who had been subjected to roentgen-ray study in a period of ten years. More than 300, or 14 per cent, showed some deformity of the duodenum. Duodenal diverticulum was present in 26 cases, or 1.2 per cent. The incidence of duodenal diverticulosis, as ascertained by roentgenologic gastrointestinal study, is now held to be about 1 per cent of all persons submitted to this examination.

Duodenal diverticula are of two types; namely, congenital and acquired. Congenital diverticula are present from birth, although they may give rise to no symptoms. They are believed to represent an abortive attempt at the formation of a supernumerary pancreas. In some cases, the diverticulum itself is not present at birth, but there are collections of pancreatic cells of embryonic type causing local defects in the wall of the gut. Then, under the influence of age, intestinal atony or a sudden increase in the intraduodenal pressure, the resistance of the wall is overcome so as to form a pouch.

Acquired duodenal diverticula are due to some extrinsic factor, such as the traction influence of adhesions to the gallbladder or pancreas, a duodenal ulcer, or some other upper abdominal lesion. They may in turn be divided into two types; namely, true and false. The true diverticulum contains all the coats of the bowel;

whereas the false one consists of only the mucous, submucous and serous coats, being devoid of the muscular layer. In this respect, the distinction is similar to that between true and false aneurysms.

The second portion of the duodenum, close to the ampulla of Vater, is the most common site of a diverticulum. The pouch most often arises from the inner and posterior surface of the intestine, lying close to the pancreas. As a rule, there is only one pouch; but there may be as many as four. Usually the pouch has a small neck by which it communicates with the cavity of the duodenum.

In the case of true diverticulum, the structure is in many respects similar to that of the rest of the duodenum. The crypts of Lieberkühn are present, but not Brunner's glands. Embedded in the mucous membrane of the pouch, there may be fragments of pancreatic tissue of the embryonic type.

Moore[5] of the Mayo Clinic believes that true duodenal diverticulum is an extremely rare condition. In his experience, these pouches are usually located on the greater curvature side of the duodenum, that is the lower border, and are in a high percentage of cases associated with duodenal ulcer. He believes that many of the diverticula of the first portion of the duodenum reported in the literature are not true diverticula but simply pouchings caused by the contraction of an ulcer.

According to Cole and Roberts,[6] the roentgen finding characteristic of duodenal diverticulum is a localized accumulation of the opaque substance adjacent to the duodenum. It may be so small as to be scarcely visible or as large as an egg. It may be apparent immediately after taking the opaque meal or as late as six hours afterward. If it is visible twenty-four hours after the evacuation of the stomach, this finding is of importance in the differential diagnosis of renal calculi and gallstones.

As there are no typical or even suggestive symptoms, the diagnosis of duodenal diverticulum cannot be made clinically. There may be symptoms simulating peptic ulcer, cholecystitis or pancreatitis; but, as Kampmeier[7] has pointed out, the diagnosis is made almost without exception as an accidental finding during a barium meal examination.

With regard to operative technique, Maclean[8] divides diverticula into three classes: (1) those on the anterior peritoneal surface of the duodenum; (2) those embedded in the pancreas, and (3) those behind the pancreas or in the retroperitoneal space.

Pedunculated diverticula of the first class, according to Maclean, may be ligated at the base; then the stump should be treated with carbolic acid and buried with a purse-string suture. A corner of the great omentum may be anchored over it for security. If the diverticulum is sessile, or has a broad base, it is sufficient to excise it or invert it with Lembert sutures placed so that the line of suture is at right angles to the long axis of the duodenum.

When the diverticulum is embedded in the pancreas, its removal is very difficult. When it is located behind the pancreas, the duodenum and pancreas must be mobilized before removing the pouch.

## REPORT OF CASES

Case 1. H. S., male, aged forty-nine, complained of constant epigastric pain of two years' duration. The onset of the pain was not related to the taking of food. However, food eased the pain and the patient therefore ate at frequent intervals. Weakness, loss of weight and loss of ambition were prominent symptoms. An appendectomy had been performed a few months previously, but the pain was not relieved thereby.

The subject was markedly undernourished. Rectal examination revealed a spacious ampulla recti. Otherwise, physical examination was negative.

Study of the gastric contents gave normal acid values. There was no occult blood in the feces. Urine and blood count were normal.

Combined roentgenoscopy and roentgenography of the gastrointestinal tract revealed a persistently distorted and dilated duodenal cap (Fig. 1). There was a shadow characteristic of a duodenal diverticulum or an accessory pocket adjacent to the lesser curvature of the duodenum.

A large six-hour residue remained in the bulbus duodeni. A second observation six and seven hours respectively after barium ingestion showed a smaller residue than at the first

visualization. What appeared to be a duodenal diverticulum was outlined by the opaque substance. Cholecystography showed poor concentration of bile, but the morphology of the gall-bladder was normal.

Four diagnostic possibilities were suggested by the roentgenologic findings:

(3) Periduodenitis secondary to duodenal ulcer, involving and obstructing the pars inferior duodeni and causing the unusual dilatation of the bulb behind it.

(4) Stenosis of the second portion of the duodenum due to adhesions to a pathologic biliary apparatus. This would account for the

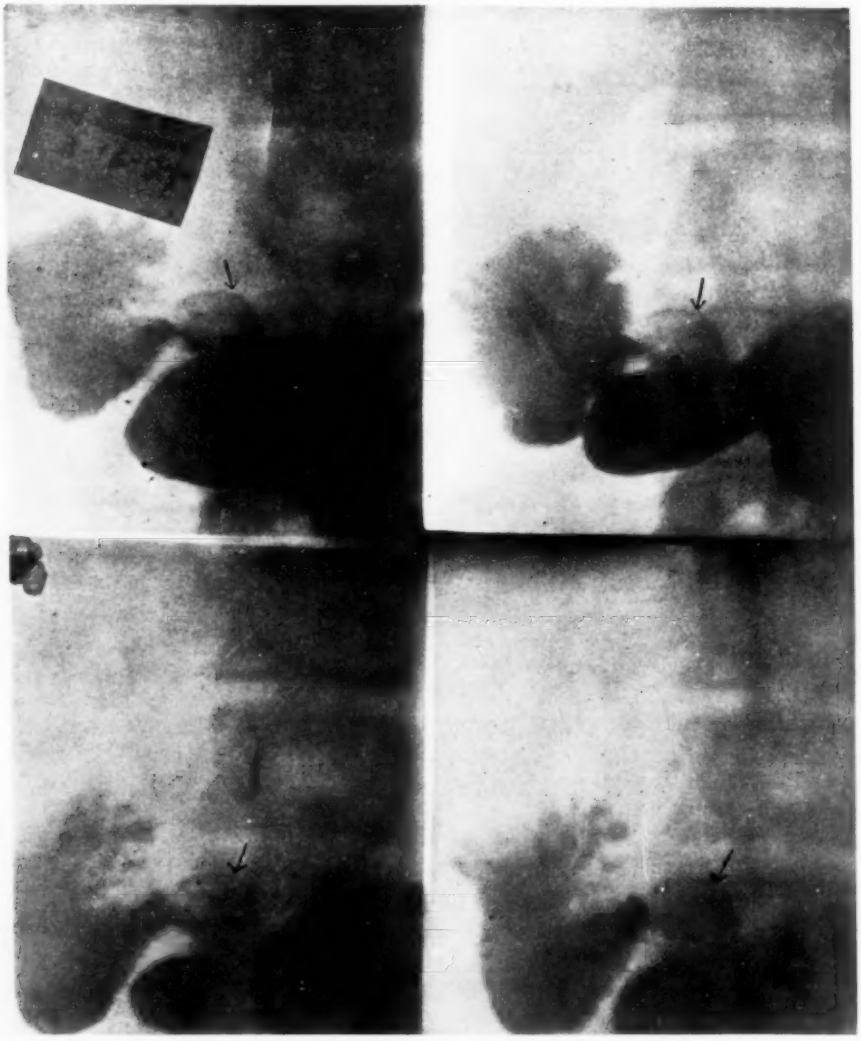

Fig. 1.

(1) An accessory duodenal pocket resulting from perforation and healing of a duodenal ulcer. This pocket was somewhat spherical and appeared to communicate with the lumen of the duodenum at the lesser curvature.

(2) Duodenal diverticulum appearing as a sac-like addition to the bulb proximal to the site of an ulcer. This would explain the enlargement of the basal portion of the bulb.

six and seven hour residues in the bulb as well as the accessory pocket.

The most probable diagnosis from the standpoint of the roentgen-ray findings appeared to be a duodenal diverticulum in association with a partially stenosing ulcer. The dilated appearance of the bulb, as judged from the six and seven hour residues, supported this view. However, in the absence of a history pointing

to ulcer, the probabilities in favor of uncomplicated duodenal diverticulum appeared greater. Since there was no jaundice and the feces were normal macroscopically and microscopically, involvement of the head of the pancreas could be eliminated.

It was believed that the definite roentgenologic findings, the comparatively short duration of the illness, the quiescent clinical picture, and the progressive loss of weight in a man of cancer age warranted an exploratory opening of the right upper abdomen.

Laparotomy was performed by Dr. John F. Erdmann of the New York Post-Graduate Hospital. When the first portion of the duodenum was exposed, there was a false diverticulum—not a true one—extending up to the superior surface of the first portion of the duodenum. It was readily plicated and turned in by two rows of stitches. In addition, there was chronic cholecystitis with adhesions of the omentum to the abdominal wall and also adhesions about the cecum. The diverticulum was inverted, the gall-bladder removed and the adhesions relieved.

The patient made an uneventful recovery. He was completely relieved of his symptoms by the operation. Four months later, he wrote that he had gained weight and was feeling fine. He was again subjected to roentgenologic study in October, 1927, at which time a normal picture for the pylorus and duodenum was obtained (Fig. 2). He was still entirely free from symptoms.

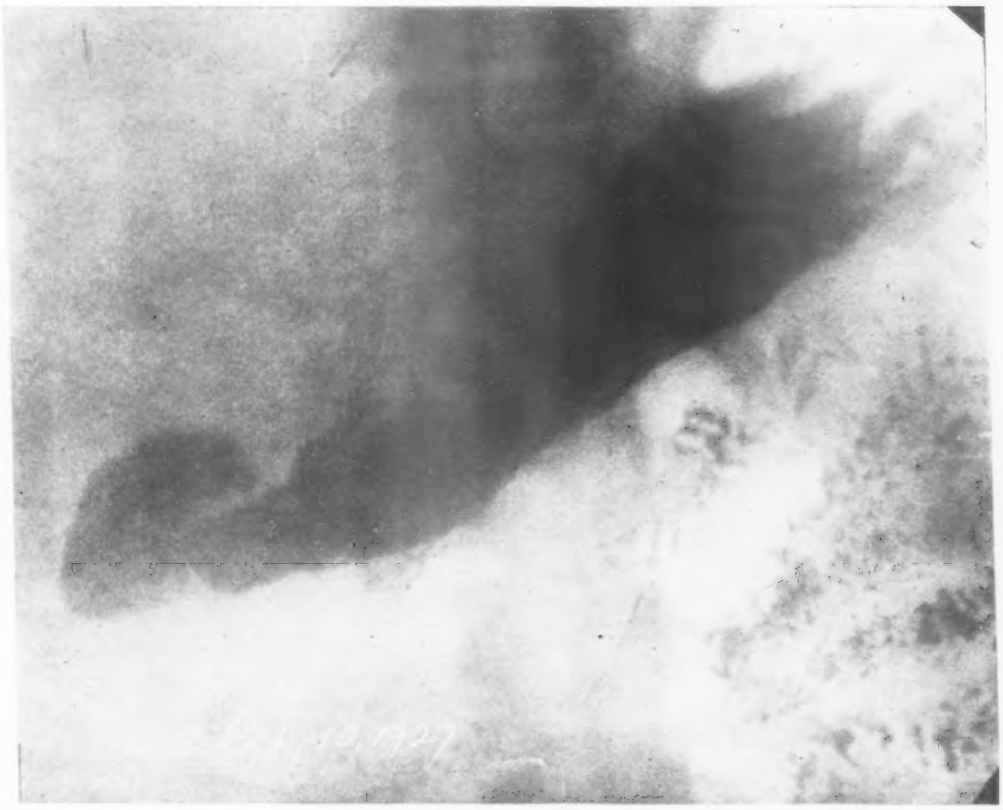

Fig. 2.

*Comment.* Since the second portion of the duodenum was much dilated, it was necessary to differentiate duodenal ileus, a condition that may result from acute gastritis. However, the stormy symptomatology of acute gastric dilatation is usually unmistakable. Chronic duodenal ileus also gives rise to serious abdominal and toxic symptoms. My case may be regarded as a partial chronic ileus brought about by adhesion of the pars inferior duodenalis to a chronically inflamed gall-bladder. In my opinion, an actual or even a pseudo-

diverticulum of the duodenum is a condition requiring surgical intervention.

This case is of interest because of (1) the infrequency of the condition, (2) the location of the diverticulum on the lesser curvature and (3) its association with partial ileus.

August, 1927, when there was a sudden return of the gastric hyperacidity syndrome. The clinical picture rapidly assumed that of duodenal ulcer, of which condition classic symptoms were present. Combined roentgenoscopy and roentgenography of the gastrointestinal tract revealed a diverticulum on the lesser

Fig. 3.

Case II. B. R., pharmacist, aged thirty-nine, complained of the typical symptoms of the gastric hyperacidity syndrome. He was in the habit of smoking from thirty-eight to forty cigarettes a day and indulged frequently in dietary indiscretions. He had been examined in 1922 and found to have clinical evidences of hyperacidity together with a high acidity curve as ascertained by Rehfuss fractional gastric analysis. Except for marked gastrocoloptosis and spastic constipation, roentgenologic examination of the gastrointestinal tract revealed no abnormality.

The patient did fairly well under treatment and was not troubled by symptoms until

curvature of the duodenal bulb (Fig. 3), in all respects like that found in Case I.

The patient was operated upon by Dr. Philip Grausman at the Hospital for Joint Diseases. Dr. Grausman reported his findings as follows:

"Numerous adhesions extending from the transverse colon were found on the under surface of the gall-bladder. There was also a band of adhesions which extended across from the duodenum so as to make a sacculation about the size of a hazelnut on its first portion. This band was freed and the sacculation inverted with two layers of catgut, after which the inversion of the duodenal sac was completed. The gall-bladder was found to empty

easily and to be free from adhesions. The appendix was kinked on itself; it was therefore liberated and removed."

The patient made an uneventful recovery and his gastric and duodenal symptoms were greatly ameliorated. It is too early, however, to report the final result.

*Comment.* There are three points of interest in this case:

(1) Since the duodenum was roentgen rayed in 1922 and found free from any deformity of the bulb, the lesion must have been acquired, not congenital.

(2) Although the diverticulum was not produced by the contraction of an ulcer bed, the clinical picture was typically that of a duodenal ulcer.

(3) Since a band of adhesions extending from the duodenum to the gall-bladder produced the sacculation, the condition in this case may well be called a *traction diverticulum.*

## CONCLUSIONS

1. Diverticulum of the duodenum is not so rare as is commonly supposed, being found in more than 1 per cent of all routine roentgenologic examinations of the gastro-intestinal tract for digestive disturbances.

2. Usually there are no characteristic symptoms, the condition being discovered accidentally.

3. True diverticulum is a congenital anomaly; false diverticulum, the result of perforation and healing of an ulcer or traction of adhesions from a chronically inflamed gall-bladder.

4. The diverticulum, whether congenital or acquired, is best treated by surgical intervention.

5. Two cases are reported, in each of which roentgenologic examination and subsequent operation revealed an acquired diverticulum arising from the lesser curvature of the duodenum. In the first case, the structure of the duodenum proved it to be a false one. In the second case, the condition was due to the traction of a band of adhesions extending from the under surface of the gall-bladder to the duodenum; furthermore, in an earlier roentgenologic examination made five years previously, the duodenal bulb was found to be normal. In each case the diverticulum was inverted and stitched. Both patients made an excellent recovery after operation and have been free from symptoms ever since, although it is too early to report fully with regard to the second case.

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# TREATMENT OF PAIN IN CARCINOMA OF THE CERVIX UTERI WITH SPECIAL REFERENCE TO STRICTURE OF THE URETER*

BY CHARLES L. MARTIN, M.D.

Associate Professor of Radiology, Baylor Medical School

DALLAS, TEXAS

PAIN is rarely the initial symptom in carcinoma of the cervix. Clark and Ferguson[1] found it to be the first symptom to appear in only 5.7 per cent of 214 cases studied at the University Hospital in Philadelphia. However, in that large group of patients who consult the physician after the chance of a cure has practically vanished, pain eventually becomes the most distressing symptom to be dealt with. It unfortunately often appears while the primary tumor is showing rapid improvement under radiation therapy and after all of the other symptoms have disappeared.

There have, in our experience, been three major causes of severe pain in these cases. They are in the reverse order of their frequency: stenosis of the cervical canal, pelvic peritonitis, and stricture of the ureter. Rectal pain from pressure is occasionally encountered but its severity does not rank with that of the three conditions just mentioned.

Stenosis of the cervical canal may follow the use of large doses of radium within the cervix although it can be prevented by an occasional dilatation done at intervals after the irradiation is completed. The pain produced is quite similar to that observed with ureteral stricture as is illustrated by the following case:

CASE 1. A white woman, aged forty-eight, who had suffered from menorrhagia for many months came to the hospital for the surgical removal of a carcinoma of the cecum. While she was convalescing from the operation she had a rather large hemorrhage from the vagina.

Examination revealed a normal sized uterus in third degree retroversion. Both broad ligaments were soft. The cervix was normal in appearance. However, a curettage obtained considerable soft friable tissue from the upper cervical canal which proved on histological examination to be carcinoma of the cervix of the transitional cell type.

Twenty-four hundred milligram-hours of radium was given by means of brass capsules in the cervical canal and an additional 1200 mg-hr. was given using two Martin spools placed high in the vaginal vaults. The pelvis was then cross-fired with deep roentgen-ray therapy through three ports of entry.

The patient improved rapidly and at the end of two months had no hemorrhage nor discharge. At the end of nine months she had gained a total of 21 pounds and was in unusually good health.

However, about three months later she returned complaining of severe aching pain low in the pelvis referred to the right hip and right thigh. The symptoms were so suggestive of stricture of the ureter that cystoscopy was done, in spite of the fact that the cervix was smooth and both broad ligaments were soft. A pyelogram revealed no dilatation of the right ureter or right kidney.

The pelvic organs were then again carefully examined and the cervical canal was found to be tightly closed by adhesions. Gas was administered and a thorough dilatation of the cervix was done. A small amount of bloody fluid was released. The pain was immediately relieved and has not recurred during a subsequent two years of observation.

Pelvic peritonitis is a rather infrequent complication of radiation therapy. Schreiner and Kress[2] report it as occurring in a little over 1 per cent of a series of 404 irradiated cases, with a mortality of 4 out of 5 cases. These authors feel that the etiological factor was the gonococcus in every case. However, it seems likely that other organisms might be responsible in cases where it is necessary to open a tract through infected friable tissue for the insertion of radium capsules. When treatment is given in the presence of a preëxisting pelvic infection, and this is sometimes unavoidable, an accentuation of pain, temperature elevation and nausea frequently occur, as illustrated in the following case history:

* Read at the Twenty-eighth Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Montreal, Canada, Sept. 20–23, 1927.

Case II. A white woman, aged forty-three, entered the hospital because of vaginal hemorrhage of two years' duration, a foul discharge, a rapid loss of strength and an increasing pallor. She had had intermittent attacks of cramping pain in the lower abdomen for three weeks.

Examination revealed a large malignant crater in the cervix with a depth of approximately 2 inches. The parametrium was extensively infiltrated on both sides and the uterus was fixed in the pelvis. There was some tenderness in the right vault.

Twelve hundred milligram-hours of radium was administered, using multiple small brass capsules placed at intervals around the walls of the ulcer crater. On the following day the patient became very nauseated and vomited repeatedly. She complained of cramping pain in the lower abdomen and her temperature rose to 101°. However, her pulse did not go above 100. The white count on the second day was 12,300. The lower abdominal wall was somewhat spastic.

Ice packs were applied to the lower abdomen, the head of the bed was raised and fluids were forced by mouth and by rectum. All radiation therapy was discontinued. After four days of such treatment the pain disappeared and the temperature did not go above 99°. Another 1200 mg-hr. of radium was then administered and the pelvis cross-fired with deep roentgen-ray therapy through four ports of entry.

Two months later the patient was up and felt fairly well except for some weakness. The hemorrhage had stopped and she had very little discharge. Her temperature was normal and she had no pain.

Although cervical stenosis and pelvic peritonitis are rare causes of pain, malignant strictures of the ureters are relatively common offenders. The mechanism of the pain produced was described and illustrated by case histories in a previous article.[3] More recently Herger and Schreiner[4] have published statistics showing the presence of dilated ureters or hydronephrosis in practically half of a series of cases of advanced carcinoma of the cervix examined cystoscopically. After the strictures appear, the pain in the groin, hip, sacroiliac and thigh of the affected side becomes severe and death is, of course, not far off after both ureters become occluded. The radical operative measures recommended for relieving these strictures were reviewed in previous articles.[3,5] However, as Holz[6] has suggested, these patients are usually in poor condition and should be subjected to as little radical surgery as possible. For this reason dilatations of the strictures have been done through the cystoscope in a small group of cases with some degree of success. Unfortunately, even this method

Fig. 1. Ends of two Walther dilators used in stretching malignant ureteral strictures.

cannot be tried in a certain number of patients who do not come for treatment until the posterior wall of the bladder is so extensively involved that the ureteral orifices cannot be visualized through the cystoscope.

Urologists use different methods in dilating non-malignant strictures. Some merely insert catheters of increasing size, whereas

others attach a wax bulb to the end of a catheter of moderate size and force the bulb through the stricture. Still a third method consists of the use of the Walther instrument consisting of a metal catheter bearing a metal olive with a rubber director at its tip. Two such catheters are illustrated in Figure 1. The rather vigorous use of these instruments has seemed to produce better results than the less radical methods. The following case illustrates this point:

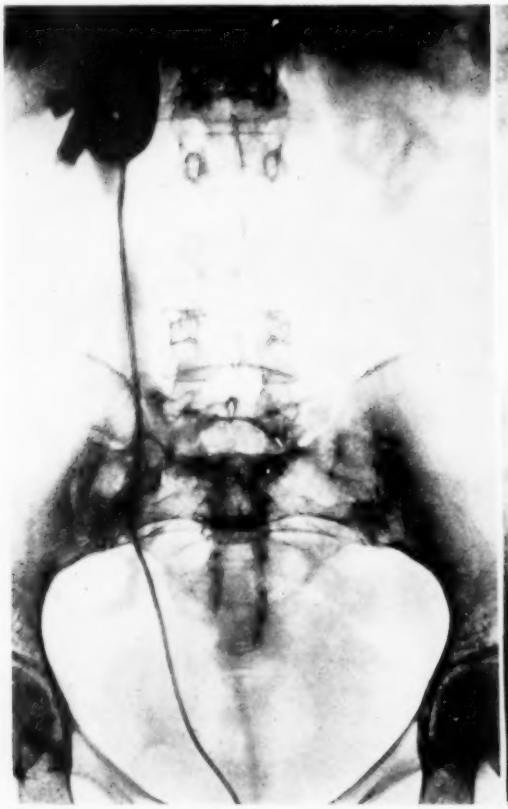

Fig. 2. Pyelogram illustrating a well-advanced hydronephrosis on the right side caused by a carcinoma of the cervix and accompanied by constant pain in the right hip and right thigh, which was relieved by dilatation of the ureteral stricture.

Fig. 3. Early hydronephrosis on right side secondary to malignant extension from carcinoma of the cervix, and accompanied by severe pain in the right hip and right thigh, temporarily relieved by dilatation of the ureteral stricture.

Case III. A white woman, aged forty-six, entered the hospital because of a continuous bloody vaginal discharge of six months' duration. She complained of increasing weakness but no pain. The cervix was almost completely destroyed and contained the crater of a large malignant ulcer that extended well up into the body of the uterus. Both broad ligaments were indurated and the uterus was fixed to the pelvic walls.

The pelvis was cross-fired with deep roentgen-ray therapy through four ports of entry and 2400 mg-hr. of radium was given with multiple brass capsules packed within the ulcer crater.

Steady improvement was noted for six weeks, at the end of which time the patient began to complain of constant aching pain in the right hip and right thigh. The hemorrhage and discharge had ceased. Cystoscopy was done and the urologist slipped a catheter of moderate size into the right ureter with ease. He felt that there was no stricture present and made no further effort at dilatation. However, a pyelogram showed a definite hydronephrosis, as illustrated in Figure 2. The patient went home but returned in two weeks because of the pain which she said was still present in an aggravated form. Cystoscopy was performed again but on this occasion a thorough dilata-

tion was done with the Walther dilator. The pain was worse for forty-eight hours and she passed some blood in the urine. She then became quite comfortable and has remained so during two weeks of observation.

The duration of relief obtained by this method cannot be forecast. If the malignant process has actually invaded the ureter or is growing rapidly about it, only temporary improvement can be hoped for. The following case probably relapsed because of continued progress of the disease:

FIG. 4. Pyelogram of the left ureter made about ten days after the onset of pain in the left sacroiliac region, left hip and left thigh in a case of carcinoma of the cervix with lateral extension. Dilatation of the stricture relieved the pain for six months.

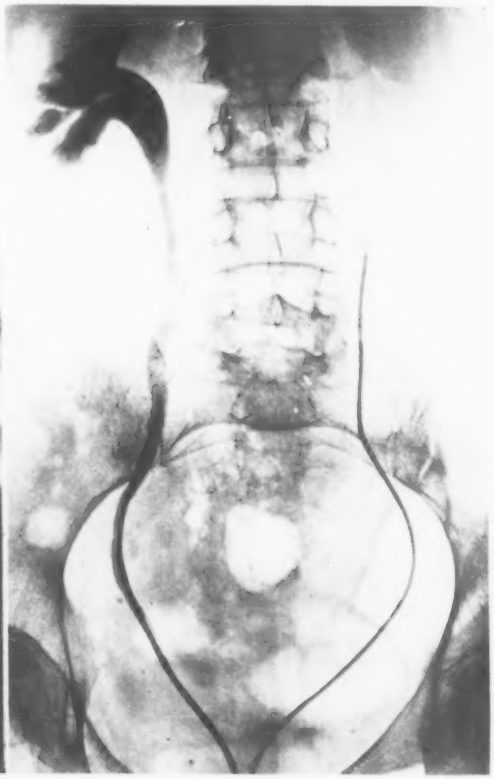

FIG. 5. Hydronephrosis on left side secondary to carcinoma of the cervix and accompanied by severe pain in the left hip, groin, and sacroiliac. Dilatation of the stricture in the ureter has relieved the pain for a period of one year and three months.

CASE IV. A white woman, aged forty-six, had a subtotal hysterectomy done in another city because of a profuse menorrhagia with an intermittent metrorrhagia of two years' duration. About five months later the cervix was cauterized because of continued hemorrhage. She was admitted to Baylor Hospital one month following the cauterization for the relief of hemorrhage which had shown no improvement.

Examination revealed a mass of shaggy semi-necrotic bleeding tissue in the region of the cervix. A specimen from this tissue proved on histological examination to be squamous cell carcinoma. Both broad ligaments were firmly indurated.

The pelvis was cross-fired through four ports of entry with deep roentgen-ray therapy and 2400 mg-hr. of radium was given using a single capsule in the cervical canal and a Martin spool in each vaginal vault.

The hemorrhage and discharge cleared up and the patient felt quite well for four months, at the end of which time she returned complaining of severe pain in the right hip and right thigh. Cystoscopy was done. No bladder involvement could be detected but a definite stricture was made out low in the right ureter with a resulting hydronephrosis, as shown in Figure 3. A thorough dilatation was done with the Walther dilator. The pain was much

accentuated, the temperature rose to 103° and there was blood in the urine for two days. However, the pain then disappeared completely and the patient went home. Three weeks later she wrote that the old symptoms had returned and were as severe as ever. She was referred to a urologist in her city for a second dilatation.

Fortunately, the results of dilatation are not always so disappointing. There seems little doubt that the two patients described in the following case histories have been saved a great deal of suffering without the use of morphine:

Case v. A white woman, aged sixty-four, was admitted to Baylor Hospital because of a bloody vaginal discharge of five months' duration, accompanied for the past three weeks by aching pain in the right hip, groin and thigh. Examination showed the upper vagina filled with friable, bleeding malignant tissue attached to the vaginal walls in sufficient quantity to obscure the cervix completely. A rectal examination revealed an indefinite mass in the region of the cervix attached by bands of induration to both pelvic walls. This induration was most marked on the right side.

The pelvis was cross-fired with deep roentgen-ray therapy through four ports of entry and 2400 mg-hr. of radium was given using multiple brass capsules placed within the malignant tissue. The symptoms all slowly cleared up and the patient returned to her home feeling well. She remained well for five months at the end of which time she returned because of severe aching pain in the left hip and left sacroiliac region referred to the left thigh. Cystoscopy was done and a small catheter was forced through a stricture low in the left ureter. A pyelogram showed a moderate dilatation of the left ureter and kidney pelvis as shown in Figure 4. The stricture was vigorously dilated with the Walther dilator. For three days following this procedure the patient was quite ill. She complained of increased pain in the pelvis and was nauseated and vomited a number of times. There was considerable blood in the urine. She was kept comfortable with morphine, chloral hydrate and bromides and on the third day her symptoms abated and she said she felt comfortable.

The pelvis was again cross-fired with deep roentgen-ray therapy and 900 mg-hr. of radium was used in the upper vagina. A recent report from the family states that the patient was free of pain for six months following the dilatation, although she is again having some discomfort.

Case vi. A white woman, aged forty-eight, had a subtotal hysterectomy done because of a blood-tinged watery discharge from the vagina of a year's duration. For five months prior to her operation she had an irregular temperature elevation accompanied by pain in the groins. This pain slowly became worse and finally was referred to the left hip and was very severe. Following operation her temperature reached 101° to 102° every day and the pain was still severe. The hemorrhage continued and showed no signs of abating.

Two weeks after operation she was placed under our care. Histological examination of the lower portion of the uterus showed squamous cell carcinoma. Examination of the patient revealed a mass of bleeding friable tissue in the upper vagina containing many small pockets of pus which were opened and disinfected. Both broad ligaments were indurated but the process was furthest advanced on the left side.

Twenty-four hundred milligram-hours of radium was given using multiple brass capsules distributed through the malignant tissue and 1200 mg-hr. was given by means of two Martin spools placed in the vaginal vaults. The pelvis was then cross-fired with deep roentgen-ray therapy through four ports of entry.

After two months the patient was well enough to be up all of the time. She had no discharge and the visible growth had practically all disappeared. However, the pain in the left sacroiliac, hip and thigh was still present and proved very troublesome.

One month later she was cystoscoped but the urologist reported that his catheter slipped into the left ureter so easily that no stricture could exist on that side. However, a pyelogram revealed a hydronephrosis, as shown in Figure 5. The patient visited the office of the urologist a number of times and the stricture was gradually dilated with a wax bulb attached to a catheter. The pelvic pain has slowly cleared up although she still has some discomfort in the left costovertebral angle at times.

A year and three months has elapsed since this patient was irradiated and she now has no symptoms referable to the carcinoma. The vaginal vault is perfectly smooth. There is still a little induration in the left broad ligament but otherwise the pelvis is negative.

Pain from malignant ureteral stricture is certainly one of the radiotherapist's most distressing problems. If it were possible to transplant the ureters into the upper portion of the bladder as recommended by Holzbach[7] when the carcinoma is moder-

ately advanced, much pain might be forestalled. However, the operation is a difficult one and the hope is always entertained that the radiation therapy may save the ureters. Ureterostomy can be performed even in well-advanced cases and may often be a life-saving procedure, but patients usually object to it bitterly and it has not been tried in our clinic. Holz[6] advises the use of indwelling catheters during treatment. We have used this method for a few days following dilatation of a stricture but have always withdrawn the catheters thinking that they might cause trouble if left in place too long. Eisendrath[8] refers to this point in a recent paper as follows: "There is no time limit. We have left the catheters *in situ* in one case of severe bilateral pyelonephritis for two weeks." It is our plan, therefore, to try indwelling catheters for longer periods in the future in obstinate cases.

Some radiologists have objected to ureteral dilatation because they feel that the carcinoma will rapidly close the openings again, all of the labor being in vain, and this objection is valid in some instances, as illustrated by Case IV. However our plan has been to irradiate the broad ligament areas as vigorously as possible using both deep roentgen-ray therapy and radium spools in the vaginal vaults at the time that the dilatations are done, hoping thereby to at least stop the progress of the malignancy in these regions. Case VI indicates that such a plan may give the patient marked relief for a considerable period of time. The colpostat recommended by Regaud[9] or the adaptation described by Kaplan[10] should deliver efficient radiation to the lowermost portion of the ureter. The greater length of our spools[11] together with the lead shields at the ends render the use of additional doses of roentgen rays relatively safe to the bladder and rectum.

I wish to express my appreciation of the valuable aid rendered us by Drs. Minnie L. Maffett, Raworth Williams and Edward White who did all of the urological work for the patients described in this paper.

## SUMMARY

1. The causes of pain most frequently encountered in treating carcinoma of the cervix are stenosis of the cervix, pelvic peritonitis, and stricture of one or both ureters.

2. Malignant ureteral strictures have been treated by dilatation through the cystoscope combined with irradiation of the broad ligament areas with definite relief of pain for varying periods of time.

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# FURTHER EXPERIMENTAL STUDIES ON THE EFFECT OF OVARIAN IRRADIATION WITH A CASTRATION DOSE OF ROENTGEN RAYS UPON FECUNDITY AND THE OFFSPRING*

BY M. R. ROBINSON, M.D.

NEW YORK CITY

IRRADIATION of human ovaries with radium or roentgen rays for the purpose of producing temporary or permanent castration is an accepted therapeutic procedure by the most prominent gynecologists and radiotherapists all over the civilized world. Notwithstanding this fact one experimental biologist warns against its employment in women of the child-bearing age, for fear that their progeny may show somatic and psychic defects. These ominous warnings are based upon experimental data obtained from the irradiation of sperm cells and eggs of toads and frogs, and one-half of the body surface of white mice, and which resulted in the reproduction of malformed offspring. Several clinicians who chanced to observe malformed children born to irradiated mothers, have linked these clinical facts with the above-mentioned laboratory data, and have concluded that temporary castration is a dangerous and unwarranted therapeutic method.

In 1927 I stated[1] that this fear need not disturb our clinical equilibrium, for the histopathologic studies of irradiated rabbit ovaries by myself and others (and since then also irradiated human ovaries), and searching and critical clinical investigations of the records of children born to irradiated mothers, failed to prove that the laboratory results obtained in very simple forms of life reproduce themselves in the human species.

In the present study, I offer biologic facts which affirm the correctness of my histopathologic and clinical conclusions, and assure us of the soundness, safety and rationale of temporary ovarian castration.

## I. CONTROL EXPERIMENT

In order to eliminate the possibility of endogenous stigmata of maldevelopment in the stock of mice used for these experiments, and to ascertain whether congenital malformations are frequent or rare in white mice, the following experiment was carried out. Three pairs of mice at the age of three months, and of an average weight of 15 gm., were mated on Dec. 30, 1926. Each pair was kept in a separate cage, and designated by a special name, pair No. 1 (Family Blecker); pair No. 2 (Family Nassau), and pair No. 3 (Family Madison).

Family Blecker

(a) Jan. 20, 1927, eight were born (Blecker No. 1), all normal, one of them died on the twentieth day after birth.

(b) Feb. 28, 1927, seven were born (Blecker No. 2), all normal.

(c) Apr. 20, 1927, a litter of eight (Blecker No. 3), all normal.

(d) June 18, 1927, a litter of six (Blecker No. 4), all normal.

(e) Sept. 2, 1927, a litter of seven (Blecker No. 5), all normal, one died at the age of two months.

(f) Oct. 28, 1927, a litter of seven (Blecker No. 6), all normal.

By the term normal I wish to imply that not only were these animals normal looking at birth, but that they also developed to maturity without showing any stigmata. After the sixth progeny, the stem family Blecker was discarded and the breeding experiments continued with its offspring.

Family Blecker No. 1: One pair of this family was mated on May 25, 1927, and observed:

(a) June 8, 1927, eight were born (Blecker No. 1a), all normal.

(b) July 25, 1927, again eight (Blecker No. 1b), all normal.

(c) Sept. 9, 1927 seven were born (Blecker No. 1c), all normal.

(d) Nov. 17, 1927, six born (Blecker No. 1d), all normal.

After the fourth progeny the family Blecker No. 1 was discarded, and the family Blecker No. 1a subjected to breeding.

Family Blecker No. 1a: One pair of this family was mated on Sept. 9, 1927.

(a) Oct. 2, 1927, a litter of eight (Blecker No. 1a1), all normal.

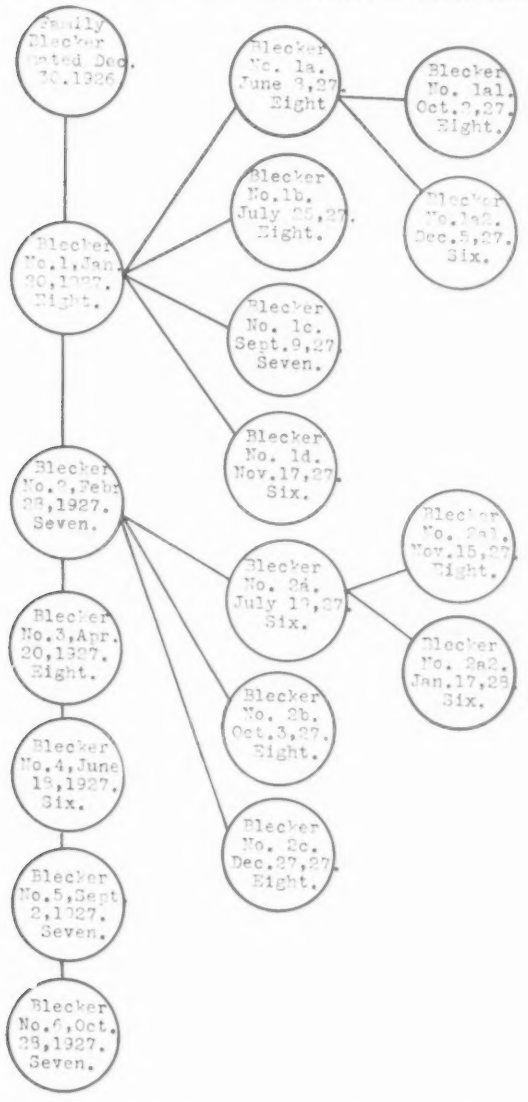
(b) Dec. 5, 1927, a litter of six (Blecker No. 1a2), all normal. The family Blecker No. 1a, is still under observation.

[1] AM. J. ROENTGENOL. & RAD. THERAPY, 1927, xviii, 1–25.

*To Dr A. Abram, my associate in radiotherapy, I wish to express my sincere thanks for his able co-operation in these experiments.

TABLE I

GENEALOGICAL TREE OF FAMILY "BLECKER," SHOWING FREQUENCY AND RATE OF PRODUCTIVITY OF WHITE MICE


Family Blecker Mated Dec. 30,1926.
Blecker No. 1a. June 9,27. Eight
Blecker No. 1a1. Oct.2,27. Eight.
Blecker No.1b. July 28,27. Eight.
Blecker No.1a2. Dec.5,27. Six.
Blecker No.1,Jan. 30,1927. Eight.
Blecker No. 1c. Sept.9,27 Seven.
Blecker No. 1d. Nov.17,27 Six.
Blecker No.2,Feb. 28,1927. Seven.
Blecker No. 2a1. Nov.15,27 Eight.
Blecker No. 2a. July 19,27 Six.
Blecker No.3,Apr. 20,1927. Eight.
Blecker No. 2a2. Jan.17,28 Six.
Blecker No. 2b. Oct.3,27. Eight.
Blecker No.4,June 13,1927. Six.
Blecker No. 2c. Dec.27,27 Eight.
Blecker No.5,Sept 2,1927. Seven.
Blecker No.6,Oct. 28,1927. Seven.

Family Blecker No. 2: One pair of this family was mated on June 1, 1927.

(a) June 19, 1927, six were born (Blecker No. 2a), all normal.

(b) Oct. 3, 1927, eight were born (Blecker No. 2b), all normal.

(c) Dec. 27, 1927, again eight (Blecker No. 2c), all normal.

After the fourth progeny the family Blecker No. 2 was no longer observed, and Blecker No. 2a subjected to further breedings.

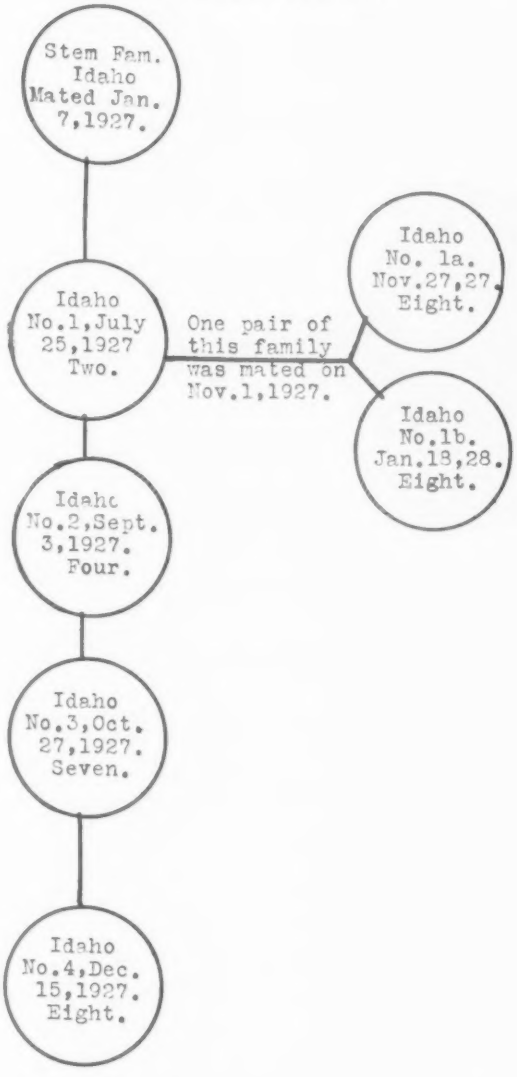
Family Blecker No. 2a: One pair of this family was mated on Oct. 19, 1927.

(a) Nov. 15, 1927, eight were born (Blecker No. 2a1), all normal.

(b) Jan. 17, 1928, six were born (Blecker No. 2a2), all normal.

TABLE II

GENEALOGICAL TREE OF FAMILY "IDAHO," FEMALE CASTRATED ROENTGENOLOGICALLY ON JAN. 7, 1927, AND MATED ON SAME DAY


Stem Fam. Idaho Mated Jan. 7,1927.
Idaho No. 1a. Nov.27,27. Eight.
Idaho No.1,July 25,1927 Two.
One pair of this family was mated on Nov.1,1927.
Idaho No.1b. Jan.18,28. Eight.
Idaho No.2,Sept. 3,1927. Four.
Idaho No.3,Oct. 27,1927. Seven.
Idaho No.4,Dec. 15,1927. Eight.

Of the families "Nassau" and "Madison" only four litters of each were observed, and since they all proved to be normal specimens, further study was discontinued. For the sake of clarity as to the fertility of white mice genealogical trees of the family Blecker, and of all other matings are appended.

### II. EXPERIMENTS WITH ROENTGEN CASTRATED FEMALES MATED AT VARIED INTERVALS AFTER IRRADIATION

In this experiment 9 females were irradi-

TABLE III

GENEALOGICAL TREE OF FAMILY "WISCONSIN." FEMALE CASTRATED ROENTGENOLOGICALLY ON JAN. 10, 1927, AND MATED ON SAME DAY

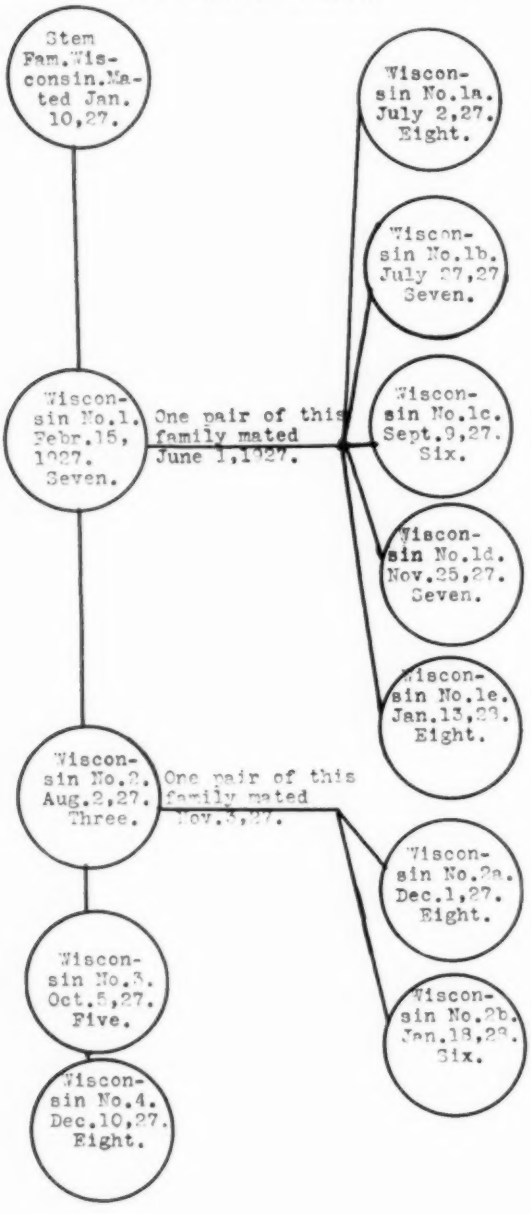
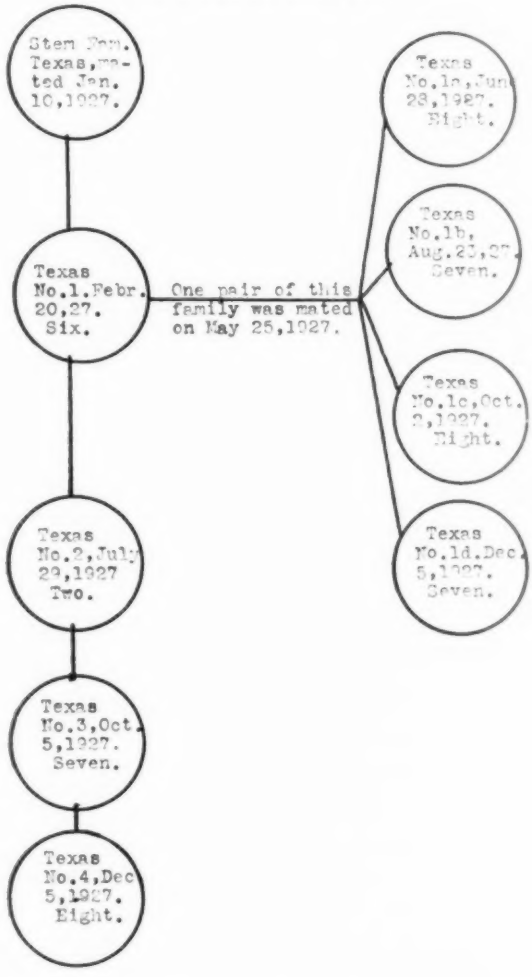

Stem Fam. Wisconsin. Mated Jan. 10,27.
Wisconsin No.1. Febr.15, 1927. Seven.
One pair of this family mated June 1,1927.
Wisconsin No.1a. July 2,27. Eight.
Wisconsin No.1b. July 27,27 Seven.
Wisconsin No.1c. Sept.9,27. Six.
Wisconsin No.1d. Nov.25,27. Seven.
Wisconsin No.1e. Jan.13,28. Eight.
Wisconsin No.2. Aug.2,27. Three.
One pair of this family mated Nov.5,27.
Wisconsin No.2a. Dec.1,27. Eight.
Wisconsin No.2b. Jan.18,28. Six.
Wisconsin No.3. Oct.5,27. Five.
Wisconsin No.4. Dec.10,27. Eight.

TABLE IV

GENEALOGICAL TREE OF FAMILY "TEXAS." FEMALE CASTRATED ROENTGENOLOGICALLY ON JAN. 10, 1927, AND MATED ON SAME DAY


Stem Fam. Texas, mated Jan. 10,1927.
Texas No.1. Febr. 20,27. Six.
One pair of this family was mated on May 25,1927.
Texas No.1a, Jun 28,1927. Eight.
Texas No.1b, Aug.23,27. Seven.
Texas No.1c, Oct. 3,1927. Eight.
Texas No.1d. Dec. 5,1927. Seven.
Texas No.2, July 29,1927 Two.
Texas No.3, Oct. 5,1927. Seven.
Texas No.4, Dec 5,1927. Eight.

ated with a mouse castration dose of roentgen rays, and mated with 9 non-irradiated males at the following intervals after irradiation: (*a*) Three pairs mated soon after irradiation; (*b*) three pairs two weeks after irradiation, and (*c*) three pairs four weeks thereafter. In order that these experiments may be verified by other observers I will state the technique and the conditions of these experiments in full.

*Technique and Conditions of the Experiments.* It was my aim to carry out my experiments on the white mice under as closely allied physical and biologic conditions as obtain clinically during an ovarian irradiation with a castration dose of roentgen rays. These conditions are the following: 200 kv.; filter, 0.5 mm. copper; focal skin distance, 23 cm.; 2 ma., irradiation field 2.5 sq. cm.; time of exposure, 21 minutes; and the dose was 35 per cent of the skin erythema dose of the mouse (which according to Holfelder and Abrahams is four times that of the human).

TABLE V

GENEALOGICAL TREE OF FAMILY "MEXICO." FEMALE CASTRATED ROENTGENOLOGICALLY ON JAN. 10, 1927, AND MATED ON JAN. 24, 1927

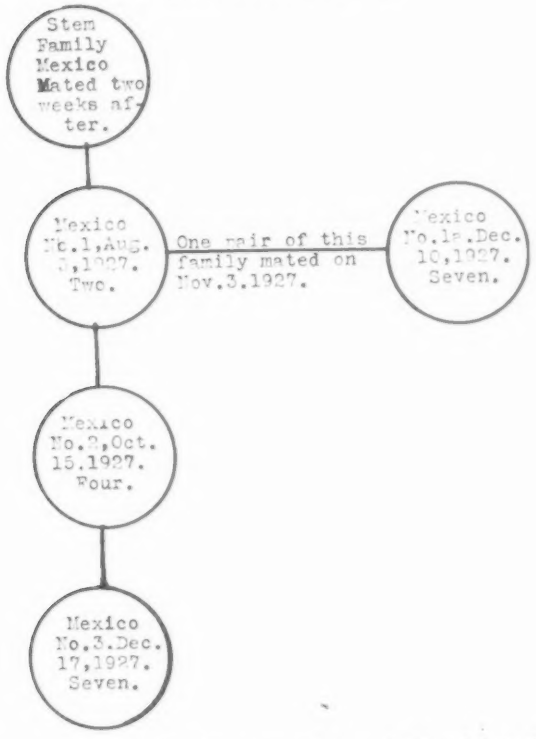
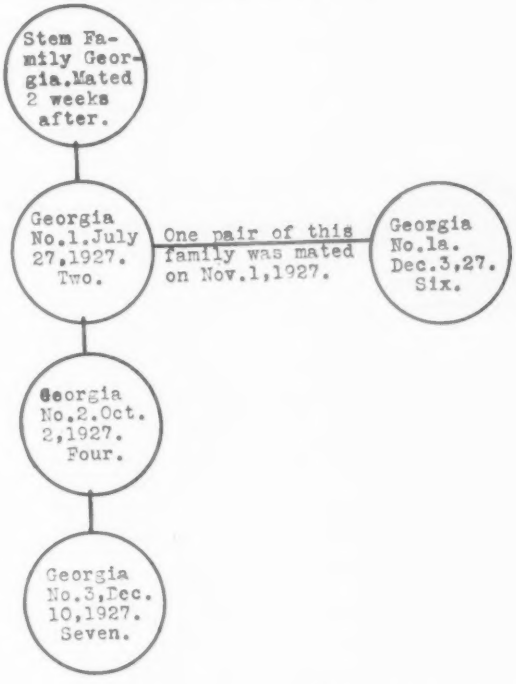

Stem Family Mexico Mated two weeks after.
Mexico No.1,Aug. 3,1927. Two.
One pair of this family mated on Nov.3.1927.
Mexico No.1a.Dec. 10,1927. Seven.
Mexico No.2,Oct. 15.1927. Four.
Mexico No.3.Dec. 17,1927. Seven.

TABLE VI

GENEALOGICAL TREE OF FAMILY "GEORGIA." FEMALE CASTRATED ROENTGENOLOGICALLY ON JAN. 10, 1927, AND MATED ON JAN. 24, 1927


Stem Family Georgia.Mated 2 weeks after.
Georgia No.1.July 27,1927. Two.
One pair of this family was mated on Nov.1,1927.
Georgia No.1a. Dec.3,27. Six.
Georgia No.2.Oct. 2,1927. Four.
Georgia No.3,Dec. 10,1927. Seven.

To obtain the size of the field of irradiation, it was essential to determine what dimensional proportion the irradiation field in the mouse should bear to its body surface area, when compared with the proportion which the fields of exposure employed in human ovarian castration bear to the body surface.

According to Rubner,[1] small animals, particularly the young, have a relatively much larger body surface in proportion to their weight than larger animals. Rubner states further that the body surface of the white mouse is 2,296 sq. cm. per kilogram, while that of the human being is only 287 sq. cm. per kilogram. In other words, the proportion between the body surface and the weight in an adult white mouse is eight times as large as in the human. For younger mice averaging about 15 gm. in weight the proportional body surface would be greater and the ratio of the surface to that of the human being would be greater than eight. Although the precise ratio was not determined the value ten was arbitrarily selected, especially since the size of the tube used made this selection convenient.

According to Seitz and Wintz human castration with roentgen rays is obtained by irradiation through four fields each $6 \times 8$ cm., or a total of 192 sq. cm., and if the total surface area of the human is taken as 17,200 sq. cm. and that of a three months old white mouse as 22.5 sq. cm., then the size of the irradiation field for the castration of a white mouse is obtained from the following equation:

$$17{,}200 : 192 :: 22.5 : x$$
$$x = 0.25 \text{ sq. cm.}$$

Now, if the roentgen effect were merely proportional to the surface area exposed the theoretical surface on the mouse necessary to be irradiated to correspond to the castration dose in the human would be 0.25 sq. cm. However, we have indicated above that weight for weight the body surface of the mouse is about ten times that

[1] Landois, L. Lehrbuch der Physiologie des Menschen. Sixteenth edition. Bearbeitet von R. Roseman. Urban and Schwarzenberg, Berlin, 1919, p. 347.

TABLE VII

GENEALOGICAL TREE OF FAMILY "PANAMA." FEMALE CASTRATED ROENTGENOLOGICALLY ON JAN. 12, 1927, AND MATED ON JAN. 26, 1927

for man, hence multiplying 0.25 by ten we obtain 2.5 sq. cm.

*A. Matings Immediately after Irradiation.*

Family Idaho: mated on Jan. 7, 1927, immediately after the irradiation:

(a) July 25, 1927, a litter of two (Idaho No. 1), both were normal and developed into mature specimens.

(b) Sept. 3, 1927, a litter of four (Idaho No. 2), all normal, and no evidences of maldevelopment later on.

(c) Oct. 27, 1927, seven young born (Idaho No. 3), all normal.

(d) Dec. 15, 1927, eight young born (Idaho No. 4), all normal. After the fourth litter this family was discarded, and its progenies Idaho No. 1, and Idaho No. 2, were submitted to breeding and observation.

Family Idaho No. 1: One pair of this family was mated on Nov. 1, 1927:

(a) Nov. 27, 1927, a litter of eight (Idaho No. 1a), all normal.

(b) Jan. 18, 1928, a litter of eight (Idaho No. 1b), all normal (Fig. 3).

Family Wisconsin: Female irradiated on Jan. 10, 1927, and mated immediately thereafter:

(a) Feb. 15, 1927, a litter of seven (Wisconsin No. 1), all normal.

(b) Aug. 2, 1927, a litter of three (Wisconsin No. 2), all normal.

(c) Oct. 5, 1927, a litter of five (Wisconsin No. 3), all normal.

(d) Dec. 10, 1927, a litter of eight (Wisconsin No. 4), all normal.

Family Wisconsin No. 1: One pair of this family was mated on June 1, 1927:

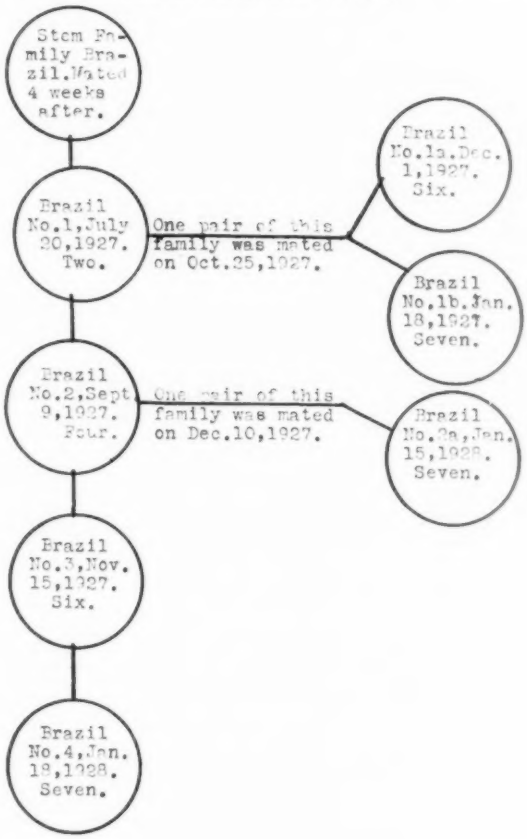
(a) July 2, 1927, a litter of eight (Wisconsin No. 1a), normal.

(b) July 27, 1927, a litter of seven (Wisconsin No. 1b), normal.

(c) Sept. 9, 1927, a litter of six (Wisconsin No. 1c), normal.

TABLE VIII

GENEALOGICAL TREE OF FAMILY "BRAZIL." FEMALE CASTRATED ROENTGENOLOGICALLY ON JAN. 12, 1927, AND MATED ON FEB. 12, 1927


Stem Family Brazil.Mated 4 weeks after.
Brazil No.1,July 20,1927. Two.
One pair of this family was mated on Oct.25,1927.
Brazil No.1a.Dec. 1,1927. Six.
Brazil No.1b.Jan. 18,1927. Seven.
Brazil No.2,Sept 9,1927. Four.
One pair of this family was mated on Dec.10,1927.
Brazil No.2a,Jan. 15,1928. Seven.
Brazil No.3,Nov. 15,1927. Six.
Brazil No.4,Jan. 19,1928. Seven.

(d) Nov. 25, 1927, a litter of seven (Wisconsin No. 1d), normal.

(e) Jan. 13, 1928, a litter of eight (Wisconsin No. 1e), normal.

Family Wisconsin No. 2: One pair of this family was mated on Nov. 3, 1927.

(a) Dec. 1, 1927, a litter of eight (Wisconsin No. 2a), all normal.

(b) Jan. 18, 1928, a litter of six (Wisconsin No. 2b), all normal.

Family Texas: Female irradiated on Jan. 10, 1927, and mated immediately thereafter.

(a) Feb. 20, 1927, a litter of six (Texas No. 1), all normal.

(b) July 29, 1927, a litter of two (Texas No. 2), all normal.

(c) Oct. 5, 1927, a litter of seven (Texas No. 3), all normal.

(d) Dec. 5, 1927, a litter of eight (Texas No. 4), all normal.

From the progeny of the Family Texas, Texas No. 1 was subjected to further breeding and observation.

Family Texas No. 1: One pair of this family was mated on May 25, 1927:

(a) June 28, 1927, a litter of eight (Texas No. 1a), all normal.

(b) Aug. 23, 1927, seven were born (Texas No. 1b), all normal.

TABLE IX

GENEALOGICAL TREE OF FAMILY "CUBA." FEMALE CASTRATED ROENTGENOLOGICALLY ON JAN. 12, 1927, AND MATED ON FEB. 12, 1927

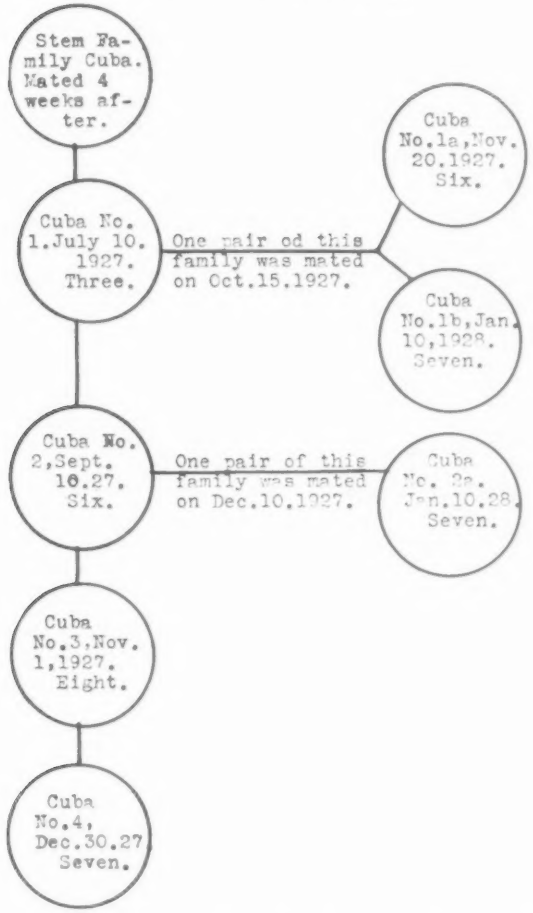
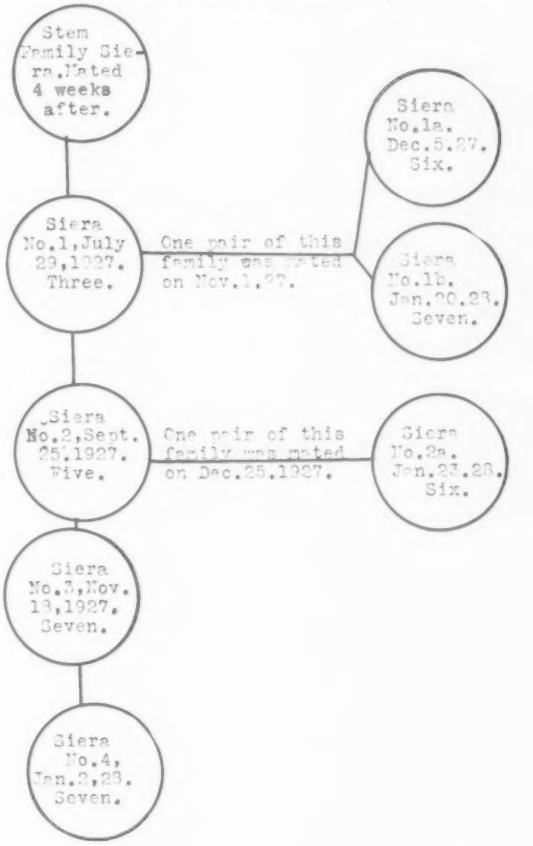

Stem Family Cuba. Mated 4 weeks after.
Cuba No. 1,July 10. 1927. Three.
One pair od this family was mated on Oct.15.1927.
Cuba No.1a,Nov. 20.1927. Six.
Cuba No.1b,Jan. 10,1928. Seven.
Cuba No. 2,Sept. 10.27. Six.
One pair of this family was mated on Dec.10.1927.
Cuba No. 2a. Jan.10.28. Seven.
Cuba No.3,Nov. 1,1927. Eight.
Cuba No.4, Dec.30.27. Seven.

TABLE X

GENEALOGICAL TREE OF FAMILY "SIERA." FEMALE CASTRATED ROENTGENOLOGICALLY ON JAN. 15, 1927, AND MATED ON FEB. 15, 1927


Stem Family Siera.Mated 4 weeks after.
Siera No.1,July 29,1927. Three.
One pair of this family was mated on Nov.1,27.
Siera No.1a. Dec.5.27. Six.
Siera No.1b. Jan.30.28. Seven.
Siera No.2,Sept. 25.1927. Five.
One pair of this family was mated on Dec.25.1927.
Siera No.2a. Jan.27.28. Six.
Siera No.3,Nov. 13,1927. Seven.
Siera No.4, Jan.2,28. Seven.

(c) Oct. 2, 1927, a litter of eight (Texas No. 1c), all normal.

(d) Dec. 5, 1927, a litter of seven (Texas No. 1d), all normal.

*Epicrisis of Experiment A.* Sterility following ovarian castration may set in immediately or after the ovulating cycle, which was in progress at the time of the irradiation, is completed. This fact is proven by the immediate sterility in the family Idaho, and by its delay in the families Wisconsin and Texas, each of whom have borne a litter of seven and eight respectively; the former five weeks, and the latter six weeks, after the irradiation. This phenomenon is also observed clinically. In some patients the roentgen amenorrhea will set in promptly, in others only after one, and at times after two, menstrual cycles have been completed. Is this occurrence a mere accident, or does it depend upon definite physiologic laws? From our knowledge of the physiology of menstruation in the human, we can readily deduce the reasons for the immediate and the deferred roentgen amenorrhea or sterility in the human and in the animal species. If the roentgen castration was administered before the fourteenth or the eighteenth day of the menstrual cycle, i.e., before the ripening ovule has made its escape from the ovary, and before the formation of the corpus luteum, and the accompanying endometrial hyperplasia, then this ovule is destroyed, and the expected pregravid or premenstrual state remains suspended, hence no menstruation. But if the irradiation takes place after the ovule has been expelled, then the corpus luteum and the uterine mucosa remain unaffected,

TABLE XI

GENEALOGICAL TREE OF FAMILY "HUDSON." MALE CASTRATED ROENTGENOLOGICALLY ON MARCH 1, 1927, AND MATED ON SAME DAY

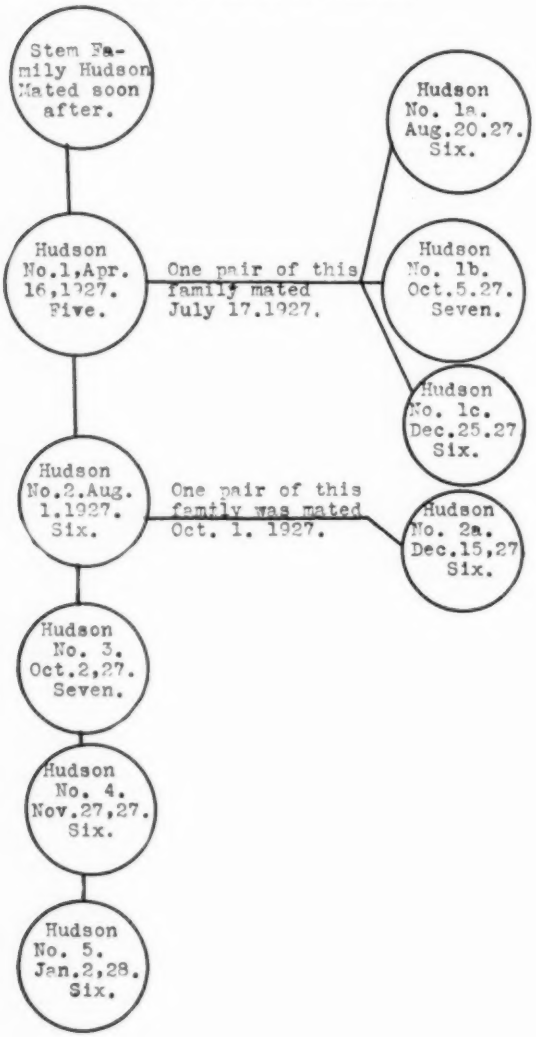

Stem Family Hudson Mated soon after.
Hudson No.1,Apr. 16,1927. Five.
One pair of this family mated July 17.1927.
Hudson No. 1a. Aug.20.27. Six.
Hudson No. 1b. Oct.5.27. Seven.
Hudson No. 1c. Dec.25.27. Six.
Hudson No.2.Aug. 1.1927. Six.
One pair of this family was mated Oct. 1. 1927.
Hudson No. 2a. Dec.15,27 Six.
Hudson No. 3. Oct.2,27. Seven.
Hudson No. 4. Nov.27,27. Six.
Hudson No. 5. Jan.2,28. Six.

TABLE XII

GENEALOGICAL TREE OF FAMILY "DELAWARE." MALE CASTRATED ROENTGENOLOGICALLY ON MARCH 1, 1927, AND MATED ON SAME DAY

Stem Family Delaware,mated soon after.
Delaware No.1. Aug.15,27. Six.
Delaware No.2. Oct.1,27. Six.
Delaware No. 3. Nov.17,27 Six.
Delaware No. 4. Jan.2,28. Seven.

and the pregravid or premenstrual states may proceed to their full development in a normal manner, and the effect of the irradiation manifests itself in the follicle that is next in line of ripening. The family Idaho was irradiated before the ovules were expelled from their corresponding follicles, while the ovules of the families Wisconsin and Texas were already in the uterine horns, when the roentgen exposure took place and the impregnation followed. It is also of great importance to note that these two litters were numerically equal to the normal rate, and that neither of them showed any developmental anomalies.

The relative sterility following the roentgen castration in the white mice varied from five to six months; and the return of the procreative property was gradual. It began with the bearing of litters of two to three, instead of the normal rate of six to eight, and by the end of the fifth month it reached again a normal level.

With the return of the ovulating properties, the resulting conceptions were also normal, for in none of the offspring, whether of the first or the second generations (thus far observed) has any malformation been found. The genealogic trees of families Idaho, Wisconsin and Texas represent graphically the periods of sterility ensuing after roentgen castration, and the gradual return of fecundity to normal.

*B. Matings Two Weeks after Irradiation.*

Family Mexico: castrated on Jan. 10, 1927, and mated on Jan. 24, 1927.

(a) Aug. 3, a litter of two (Mexico No. 1), all normal.

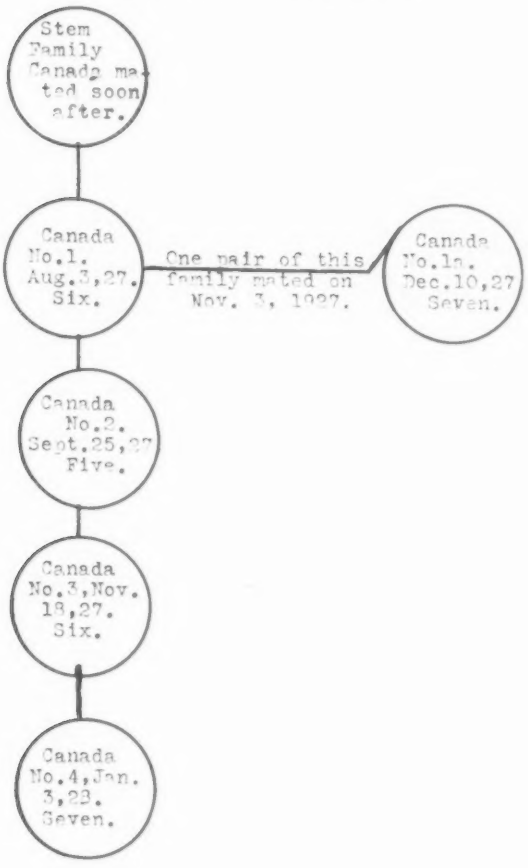
(b) Oct. 15, a litter of four (Mexico No. 2), all normal.

(c) Dec. 17, a litter of seven (Mexico No. 3), all normal.

Family Mexico No. 1: One pair of this family was mated on Nov. 3, 1927.

TABLE XIII

GENEALOGICAL TREE OF FAMILY "CANADA," MALE CASTRATED ROENTGENOLOGICALLY ON MARCH 1, 1927, AND MATED ON SAME DAY


Stem Family Canada mated soon after.
Canada No.1. Aug.3,27. Six.
One pair of this family mated on Nov. 3, 1927.
Canada No.1a. Dec.10,27 Seven.
Canada No.2. Sept.25,27 Five.
Canada No.3,Nov. 18,27. Six.
Canada No.4,Jan. 3,28. Seven.

(a) Dec. 10, a litter of seven was born (Mexico No. 1a), all normal. This litter is still under observation.

Family Georgia: castrated on Jan. 10, 1927, and mated on Jan. 24, 1927:

(a) July 27, a litter of two (Georgia No. 1), all normal.

(b) Oct. 2, a litter of four (Georgia No. 2), all normal.

(c) Dec. 10, a litter of seven (Georgia No. 3), all normal.

Family Georgia No. 1: One pair of this family was mated on Nov. 1, 1927:

(a) Dec. 3, 1927, a litter of six was born (Georgia No. 1a), all normal. This litter is still under observation.

Family Panama: castrated Jan. 12, 1927, and mated Jan. 26, 1927:

(a) Aug. 15, a litter of three (Panama No. 1), all normal.

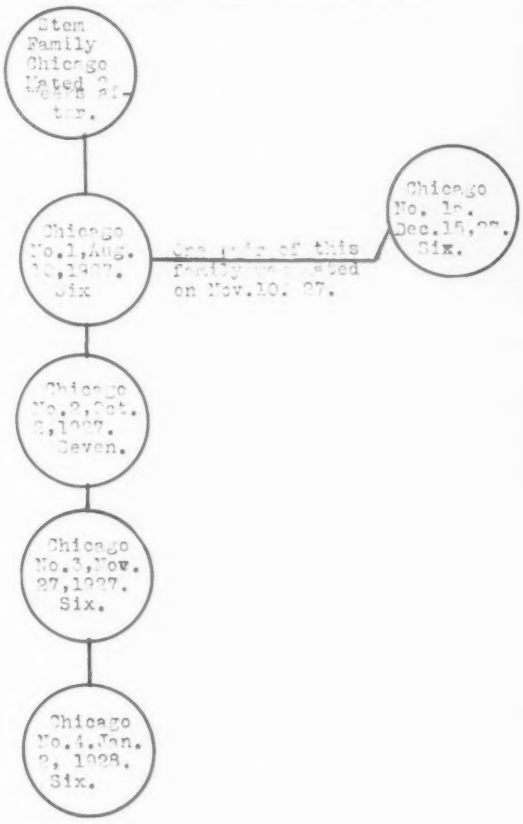
(b) Oct. 10, a litter of four (Panama No. 2), all normal.

(c) Dec. 12, a litter of six (Panama No. 3), all normal.

*Epicrisis of Experiment B.* While matings undertaken immediately after ovarian irradiation may still be fertile, as seen in experiment A, they will be absolutely sterile two weeks after roentgen castration.

TABLE XIV

GENEALOGICAL TREE OF FAMILY "CHICAGO," MALE CASTRATED ROENTGENOLOGICALLY ON MARCH 5, 1927, AND MATED TWO WEEKS LATER


Stem Family Chicago Mated 2 weeks after.
Chicago No.1,Aug. 15,1927. Six
One pair of this family mated on Nov.10. 27.
Chicago No. 1a. Dec.15,27. Six.
Chicago No.2,Oct. 2,1927. Seven.
Chicago No.3,Nov. 27,1927. Six.
Chicago No.4,Jan. 2, 1928. Six.

The period of relative sterility in this experiment was of equal duration as in experiment A, varying from five to six months.

The return of the procreative function was in this instance also gradual and progressive in character, beginning with the bearing of litters of two to three young, and finally reaching the average rate of six in the third pregnancy. The fecundity in the progeny of the first generation was normal from the very beginning.

*C. Matings Four Weeks after Irradiation.*

Family Brazil: irradiated on Jan. 12, 1927, and mated on Feb. 12, 1927:

(a) July 20, a litter of two (Brazil No. 1), all normal.

(b) Sept. 9, a litter of four (Brazil No. 2), all normal.

(c) Nov. 15, a litter of six (Brazil No. 3), all normal.

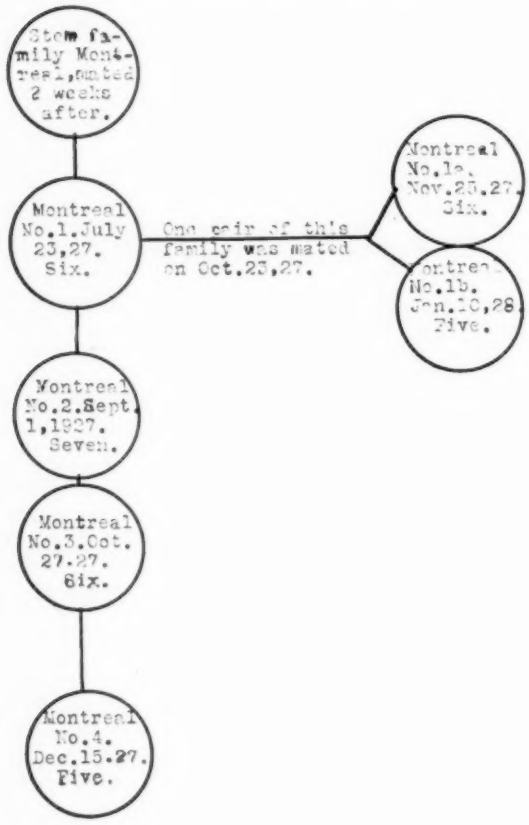
(d) Jan. 18, 1928, a litter of seven (Brazil No. 4), all normal.

Family Brazil No. 1: One pair of this family was mated on Oct. 25, 1927:

(a) Dec. 1, a litter of six (Brazil No. 1a), all normal.

TABLE XV

GENEALOGICAL TREE OF FAMILY "MONTREAL." MALE CASTRATED ROENTGENOLOGICALLY ON MARCH 5, 1927, AND MATED TWO WEEKS LATER


Stem family Montreal, mated 2 weeks after.
Montreal No.1. July 23,27. Six.
One pair of this family was mated on Oct. 23,27.
Montreal No.1a. Nov.23,27. Six.
Montreal No.1b. Jan.10,28. Five.
Montreal No.2. Sept. 1,1927. Seven.
Montreal No.3. Oct. 27.27. Six.
Montreal No.4. Dec.15.27. Five.

(b) Jan. 18, 1928, a litter of seven (Brazil No. 1b), all normal.

Family Brazil No. 2: One pair of this family was mated on Dec. 10, 1927:

(a) Jan. 15, 1928, a litter of seven (Brazil No. 2a), all normal.

Family Cuba: irradiated on Jan. 12, 1927, and mated on Feb. 12, 1927:

(a) July 10, a litter of three (Cuba No. 1), all normal.
(b) Sept. 10, a litter of six (Cuba No. 2), all normal.
(c) Nov. 1, a litter of eight (Cuba No. 3), all normal.
(d) Dec. 30, a litter of seven (Cuba No. 4), all normal.

Family Cuba No. 1: One pair of this family was mated on Oct. 15, 1927:

(a) Nov. 20, a litter of six (Cuba No. 1a), all normal.
(b) Jan. 10, 1928, a litter of seven (Cuba No. 1b), all normal.

Family Cuba No. 2: One pair of this family was mated on Dec. 10, 1927:

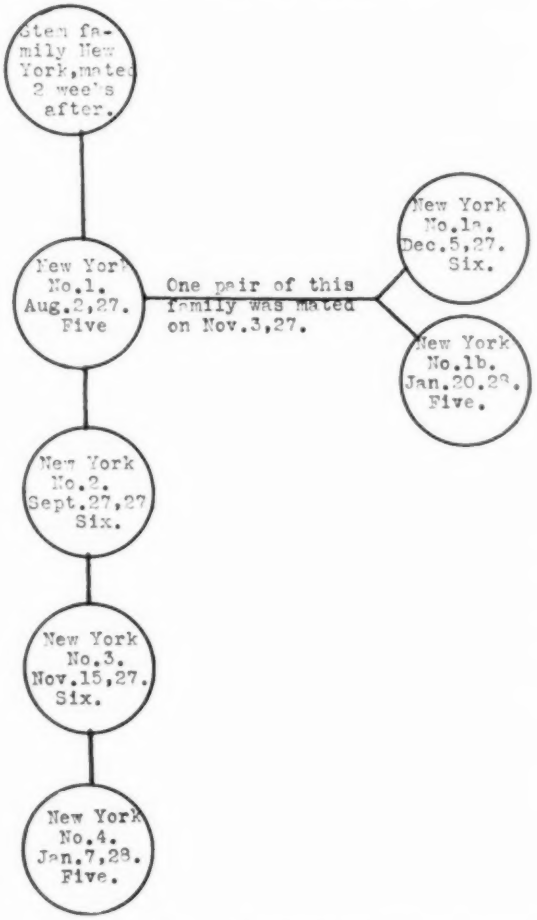
(a) Jan. 13, 1928, a litter of six (Cuba No. 2a), all normal.

Family Siera: irradiated Jan. 15, 1927, and mated Feb. 15, 1927:

(a) July 29, a litter of three (Siera No. 1), all normal.
(b) Sept. 25, a litter of five (Siera No. 2), all normal.
(c) Nov. 18, a litter of seven (Siera No. 3), all normal.
(d) Jan. 2, 1928, a litter of seven (Siera No. 4), all normal.

TABLE XVI

GENEALOGICAL TREE OF FAMILY "NEW YORK." MALE CASTRATED ROENTGENOLOGICALLY ON MARCH 5, 1927, AND MATED TWO WEEKS LATER


Stem family New York, mated 2 weeks after.
New York No.1. Aug.2,27. Five
One pair of this family was mated on Nov.3,27.
New York No.1a. Dec.5,27. Six.
New York No.1b. Jan.20,28. Five.
New York No.2. Sept.27,27 Six.
New York No.3. Nov.15,27. Six.
New York No.4. Jan.7,28. Five.

Family Siera No. 1: One pair of this family was mated on Nov. 1, 1927:

(a) Dec. 5, 1927, a litter of six (Siera No. 1a), all normal.
(b) Jan. 20, 1928, a litter of seven (Siera No. 1b), all normal.

Family Siera No. 2: One pair of this family was mated on Dec. 25, 1927:

(a) Jan. 23, 1928, a litter of six (Siera No. 2a), all normal.

*Epicrisis of Experiment C.* The period of relative sterility in this experiment was of equal length as in experiment B, about five months, and the regained fertility was also of a gradual nature. Although this experiment was not carried as far as the previous one on account of lack of time for further observation (which is going on, and will be published later), we can nevertheless state now that the repro-

ductive power in the second generation is normal, as evidenced by the normal rate of the litters borne and the appearance of the young.

### III. EXPERIMENTS WITH ROENTGEN CASTRATED MALES MATED AT VARIED INTERVALS AFTER THE IRRADIATION

Nine healthy males were chosen for this experiment. The experimental conditions remained the same as those with the females, and they were mated with nine non-irradiated females at the following time intervals: immediately, after two weeks, and after four weeks.

*A. Matings Immediately after Irradiation.*

Family Hudson: Male irradiated on March 1, 1927, and mated with a non-irradiated female on the same day:

(a) April 16, 1927, a litter of five (Hudson No. 1), all normal.

(b) Aug. 1, a litter of six (Hudson No. 2), all normal.

(c) Oct. 2, a litter of seven (Hudson No. 3), all normal.

(d) Nov. 27, a litter of six (Hudson No. 4), all normal.

(e) Jan. 2, 1928, a litter of six (Hudson No. 5), all normal.

Family Hudson No. 1: One pair of this family was mated on July 17, 1927:

(a) Aug. 20, a litter of six (Hudson No. 1a), all normal.

(b) Oct. 5, a litter of seven (Hudson No. 1b), all normal.

(c) Dec. 25, a litter of six (Hudson No. 1c), all normal.

Family Hudson No. 2: One pair of this family was mated on Oct. 1, 1927:

(a) Dec. 15, 1927, a litter of six (Hudson No. 2a), all normal.

Family Delaware: Male irradiated on March 1, 1927, and mated with a non-irradiated female on the same day:

(a) Aug. 15, 1927, a litter of six (Delaware No. 1), all normal.

(b) Oct. 1, 1927, a litter of six (Delaware No. 2), all normal.

(c) Nov. 17, 1927, a litter of six (Delaware No. 3), all normal.

(d) Jan. 2, 1928, a litter of seven (Delaware No. 4), all normal.

Family Canada: Male irradiated on March 1, 1927, and mated with a non-irradiated female on the same day:

(a) Aug. 3, 1927, a litter of six (Canada No. 1), all normal.

(b) Sept. 25, 1927, a litter of five (Canada No. 2), all normal.

(c) Nov. 18, 1927, a litter of six (Canada No. 3), all normal.

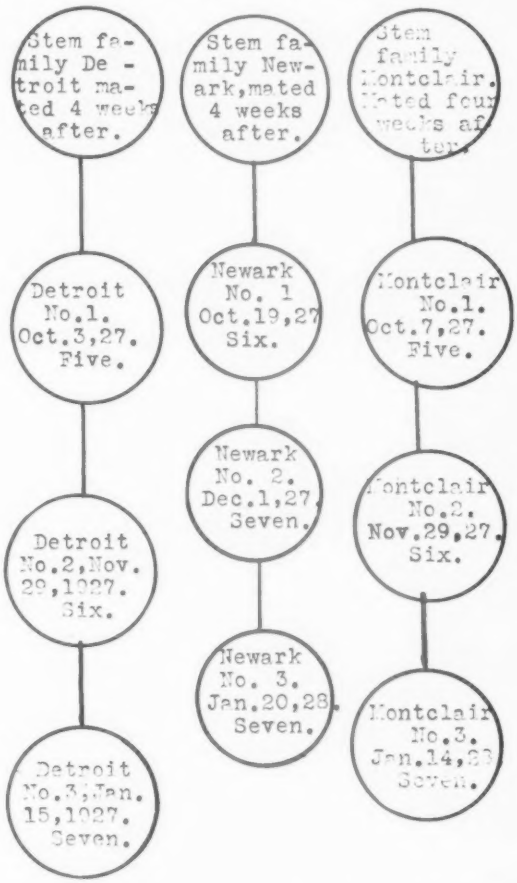
(d) Jan. 3, 1928, a litter of seven (Canada No. 4), all normal.

Family Canada No. 1: One pair of this family was mated on Nov. 3, 1927:

(a) Dec. 10, 1927, a litter of seven (Canada No. 1a), all normal.

TABLE XVII

1. GENEALOGICAL TREE OF FAMILY "DETROIT." MALE CASTRATED ROENTGENOLOGICALLY ON MARCH 10, 1927, AND MATED FOUR WEEKS LATER
2. GENEALOGICAL TREE OF FAMILY "NEWARK." MALE CASTRATED ROENTGENOLOGICALLY ON MARCH 10, 1927, AND MATED FOUR WEEKS LATER
3. GENEALOGICAL TREE OF FAMILY "MONTCLAIR." MALE CASTRATED ROENTGENOLOGICALLY ON MARCH 10, 1927, AND MATED FOUR WEEKS LATER


Stem family Detroit mated 4 weeks after.
Stem family Newark, mated 4 weeks after.
Stem family Montclair. Mated four weeks after.
Detroit No. 1. Oct. 3, 27. Five.
Newark No. 1 Oct. 19, 27 Six.
Montclair No. 1. Oct. 7, 27. Five.
Detroit No. 2, Nov. 29, 1927. Six.
Newark No. 2. Dec. 1, 27. Seven.
Montclair No. 2. Nov. 29, 27. Six.
Detroit No. 3, Jan. 15, 1927. Seven.
Newark No. 3. Jan. 20, 28. Seven.
Montclair No. 3. Jan. 14, 28. Seven.

Family Canada No. 2: One pair of this family was mated on Dec. 25, 1927:

(a) Jan. 21, 1928, a litter of seven (Canada No. 2a), all normal.

*Epicrisis of Experiment A.* In the family Hudson the sterility did not set in before the lapse of six weeks after the irradiation, and during this interval one litter of six was born. The ensuing sterility lasted only two months. In the families Delaware and Canada, on the other hand, the roentgen castration took effect much sooner, and it lasted much longer, six months in the former, and six and a half months in the latter. The analogy between

the relative sterility in this experiment and its counterpart in the female castration, can be explained on the grounds of variations in the time of covering. The copulation in the Hudson family must have taken place before the sterilization effect, while in the Delaware and the Canada families it did not occur until the return of the temporarily lost virility. It is also worthy of note, that in this experiment the return of the fecundity was prompt instead of gradual, for the number of young in each litter born after the return of the sexual powers, equalled the normal rate. The progenies of the first and second generations of this experiment also failed to show evidences of malformations.

*B. Matings Two Weeks after Irradiation.*

Family Chicago: Male irradiated on March 5, 1927, mated with a non-irradiated female on March 19, 1927:
(a) Aug. 10, 1927, a litter of six (Chicago No. 1), all normal.
(b) Oct. 2, 1927, a litter of seven (Chicago No. 2), all normal.
(c) Nov. 27, 1927, a litter of six (Chicago No. 3), all normal.
(d) Jan. 2, 1928, a litter of six (Chicago No. 4), all normal.
Family Chicago No. 1: One pair of this family was mated on Nov. 10, 1927:
(a) Dec. 15, 1927, a litter of six (Chicago No. 1a), all normal.
Family Montreal: Male irradiated on March 5, 1927, and mated with a non-irradiated female on March 19, 1927:
(a) July 23, a litter of six (Montreal No. 1), all normal.
(b) Sept. 1, a litter of seven (Montreal No. 2), all normal.
(c) Oct. 27, a litter of six (Montreal No. 3), all normal.
(d) Dec. 15, a litter of five (Montreal No. 4), all normal.
Family Montreal No. 1: One pair of this family was mated on Oct. 23, 1927:
(a) Nov. 25, 1927, a litter of six (Montreal No. 1a), all normal.
(b) Jan. 10, 1928, a litter of five (Montreal No. 1b), all normal.
Family New York: Male irradiated on March 5, 1927, and mated with a non-irradiated female on March 19, 1927:
(a) Aug. 2, 1927, a litter of five (New York No. 1), all normal.
(b) Sept. 27, 1927, a litter of six (New York No. 2), all normal.
(c) Nov. 15, 1927, a litter of six (New York No. 3), all normal.
(d) Jan. 7, 1928, a litter of five (New York No. 4), all normal.
Family New York No. 1: One pair of this family was irradiated on Nov. 3, 1927:
(a) Dec. 5, 1927, a litter of six (New York No. 1a), all normal.
(b) Jan. 20, 1928, a litter of five (New York No. 1b), all normal.

*Epicrisis of Experiment B.* The matings following two weeks after roentgen castration of the male, are just as sterile as those occurring in the female similarly treated. But the duration of the ensuing relative sterility in this experiment was of about one-half the length of that in the female, its average was about three months, instead of six. The fecundity has at once returned to its normal state simultaneously with the return of the virility.

*C. Matings Four Weeks after Irradiation.*

Family Detroit: Male irradiated on March 10, 1927, and mated with a non-irradiated female on Apr. 8, 1927:
(a) Oct. 3, 1927, a litter of five (Detroit No. 1), all normal.
(b) Nov. 29, 1927, a litter of six (Detroit No. 2), all normal.
(c) Jan. 15, 1928, a litter of seven (Detroit No. 3), all normal.
Family Newark: Male irradiated on March 10, 1927, and mated with a non-irradiated female on Apr. 8, 1927:
(a) Oct. 10, 1927, a litter of six (Newark No. 1), all normal.
(b) Dec. 1, 1927, a litter of seven (Newark No. 2), all normal.
(c) Jan. 20, 1928, a litter of seven (Newark No. 3), all normal.
Family Montclair: Male irradiated on March 10, 1927, and mated with a non-irradiated female on Apr. 8, 1927:
(a) Oct. 7, 1927, a litter of five (Montclair No. 1), all normal.
(b) Nov. 29, 1927, a litter of six (Montclair No. 2), all normal.
(c) Jan. 14, 1928, a litter of seven (Montclair No. 3), all normal.

*Epicrisis of Experiment C.* The period of relative sterility in this experiment was double the length of that obtained in experiment B; and was equal to that of its counterpart in the female experiment, namely, of an average of six months. With the return of the virility there was also a normal return of the fecundity. No developmental anomalies were noted in these litters.

## SUMMARY

1. No matings in these experiments were undertaken before the white mice were fully three months old, and the control experiment assured us that the animals employed in this study were normal.

2. The roentgen induced "relative sterility" was of an average duration of six months in both sexes; the only exception

was the family "Montreal" in which the male was castrated, in this instance the virility returned in about three and a half months.

3. If mating takes place soon after the roentgen exposure, irrespective of whether the female or the male is the experimental object, the onset of the expected sterility may be delayed, quite frequently, until after one normal litter has been born. On the other hand, all matings occurring from two to four weeks after the roentgen induced castration, will invariably remain sterile.

4. The return of fertility is gradual and progressive in the female, and more prompt in the male.

5. The present experiments tend to prove that the castration dose of roentgen rays employed for the female is also a proper dose for the male, as seen by the almost parallel results obtained in both sexes.

6. In none of the direct progenies of the irradiated animals, nor in the offspring of these progenies, of the first and second generations, have I found (thus far) any stigmata of development. This result is similar to those obtained by other investigators (see my first publication).

7. The present biologic facts, the previously advanced histopathologic conclusions, and the results of a painstaking and searching study of the records of malformed or constitutionally inferior children, born to irradiated mothers; all these cardinal data warrant the reiteration of the previously made assertion, that *temporary sterilization in women of the child bearing age, when clinically indicated, is a safe and rational procedure.*

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*Information of interest to all readers will be found on page ii.*

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# EDITORIAL

## EXOPHTHALMIC GOITER IN CHILDHOOD

THIS editorial is written for the purpose of calling attention to a somewhat rare condition but one which is sufficiently frequent to render its recognition important. The fact that exophthalmic goiter is relatively infrequent in children may result in failure to properly diagnose the condition.

The essential facts with regard to exophthalmic goiter in childhood are set forth in an article by Helmholz[1] which gives the experience of the Mayo Clinic with this disease over a five-year period, 1921 to 1926. From January 1, 1921, to March 1, 1926, thirty cases of exophthalmic goiter were observed at the Clinic in children fourteen years of age or less. The author calls attention to the fact that the duration of symptoms varied from six months to eight years, indicating that the disease often goes unrecognized for a long time. In more than half of the cases the symptoms had been present for a year and in single cases for three, four, five and six years. The age at onset "was less than one year in one case; from one to five years in seven; six to ten years in eight; eleven to twelve years in nine, and thirteen to fourteen years in five."

The disease manifested itself largely by the same symptoms as in the adult. The author mentions one symptom, however, which seems to be more marked in children than in adults, namely, the presence of choreiform movements. The writer's experience indicates that this is probably an important symptom in children and one which may mask other signs and lead to a wrong diagnosis. Nervousness and emotional instability were marked in nearly all of the cases. Exophthalmos was definite in twenty-five of the thirty cases and in one of the other five there was the characteristic stare. Helmholz calls special attention to weakness of the quadriceps femoris in children with this disease. "This can be tested by asking the child to step up on a chair. The average child steps up without effort, raising himself slowly. The child with exophthalmic goiter, however, must get a start and steps up with effort."

The gastric crises of exophthalmic goiter are very readily mistaken for gastro-enteritis in children. The estimation of the basal metabolic rate is important in children just as it is in adults, not only for its diagnostic value but as an indication of the degree of toxicity and progress under treatment.

Helmholz summarizes the diagnostic criteria in exophthalmic goiter in children as follows: "(1) symptoms indicating an increase in metabolism, such as tachycardia, excessive perspiration, and loss of weight in spite of adequate food intake; (2) toxic symptoms, such as nervousness, hyperirritability, fatigue, and the gastrointestinal crises: (3) enlargement of the thyroid and local bruit, especially in the region of the superior thyroid artery; (4) increased metabolic rate, and (5) the reduction of the rate and rapid disappearance of toxic symptoms after the administration of large doses of iodin." He further calls attention to the fact that exophthalmic goiter is difficult to distinguish from adolescent goiter in young girls. The nervous symptoms, the enlarged thyroid and rapid pulse in these patients sometimes lead to an erroneous diagnosis of exophthalmic goiter. They do not, however, have exophthalmos, nor an increased basal metabolic rate, and the rate does not become lower upon the administration of iodine as it does in true exophthalmic goiter.

Of the thirty cases observed at the Mayo Clinic, twenty-four were operated upon. One patient died from bronchopneumonia a week after ligation, and another died "in intense metabolic reaction the day

[1] Helmholz, Henry F. Exophthalmic goiter in childhood. *J. Am. M. Ass.*, 1926, lxxxvii, 157–162; *Collected Papers of the Mayo Clinic*, 1926, xviii, 537–543.

after thyroidectomy. A third death occurred in a patient who was admitted to the hospital in crisis with pneumonia."

So far as we know, there have been no statistics published of the results of treatment of exophthalmic goiter in children by irradiation. Many such cases have received this treatment, but the results have not been segregated from those obtained at all ages. The writer's own experience is that children with exophthalmic goiter respond readily to roentgen treatment. Increasing experience with the treatment of this disease by means of the roentgen ray both in childhood and adult life has left no doubt in the writer's mind that this type of treatment is quite equal to surgery in its results. The importance of accurate diagnosis and frequent checking up by means of the basal metabolic determination cannot be too greatly emphasized. This is especially true in children since roentgen or radium treatment in simple adolescent goiter is absolutely contraindicated. When the diagnosis is assured, it is essential that the patient be kept under careful management with regard to rest and diet, and especially that there be sufficient confidence in the method of treatment and in the roentgenologist so that sufficient treatment will be administered to secure the maximum beneficial results. When such conditions prevail, the reports from roentgenologists in many localities both in this country and Europe now show fairly conclusively that roentgen or radium therapy will bring about permanent cure in a majority of patients with exophthalmic goiter.

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*Items for this column solicited promptly after the events to which they refer.*

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Twenty-ninth annual meeting, Hotel President, Kansas City, Mo., Sept. 25–28, 1928.

AMERICAN COLLEGE OF RADIOLOGY
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.
Annual meeting, 1929, to be announced.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. Fred M. Hodges, 801 West Grace St., Richmond, Va.
Annual meeting, Portland, Oregon, 1929.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. Robert J. May, St. Luke's Hospital, Cleveland, Ohio.
Fourteenth annual session, Chicago, Ill., Dec. 3–7, 1928.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.
Next annual meeting, Asheville, N. C., Nov. 12–15, 1928.

BUFFALO RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. W. T. Bronson, Englewood Hospital.
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CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. James H. West, 8314 Euclid Ave.
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DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. O. J. Shore, 2033 Park Ave.
Meets monthly on second Friday from October to May, at Wayne County Medical Society Building.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. Carl S. Oakman, Muncie, Indiana.
Annual meeting each February 22 in Indianapolis. Next meeting in Indianapolis, February, 1929.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. John D. Camp, Massachusetts General Hospital, Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. E. Everett Rowell, 200 West 59th St.
Meets monthly on third Monday, New York Academy of Medicine.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

ROENTGEN RAY SOCIETY OF CENTRAL PENNSYLVANIA
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. Eugene Pendergrass, University of Pennsylvania, Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. James M. Flynn, 282 Alexander St.
Meets monthly on the first Friday evening at 7.45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Metropolitan Building.
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. C. P. Harris, Houston, Texas.
Annual meeting, Galveston, Texas, 1928.

VIRGINIA ROENTGEN RAY CLUB
Secretary, Dr. Wright Clarkson, 205 S. Sycamore St., Petersburg, Va.
Annual meeting Oct. 17, 1928.

### British Empire

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Director, Dr. John Muir, 32 Welbeck St., London, W. 1.
Meets on the third Thursday of each month, from November to June inclusive, at 8.15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month during the winter at 8. 30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

RADIOLOGICAL SECTION, AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. C. A. Anderson, The Hospital, Dunedin.

* Secretaries of societies not here listed are requested to send the necessary information to the editor.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.
Meets monthly at Melbourne during the winter.

SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION
Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.
Next annual meeting, Charlottetown, P. E. I., June 21–23, 1928.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch.
Meets annually.

CONTINENTAL EUROPE

BELGIAN SOCIETY OF ROENTGENOLOGY
Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

SOCIETE DE RADIOLOGIE MÉDICALE DE FRANCE
Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

SOCIETE FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE
Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHOSLOVAKIA
Secretary, Dr. Walter Altschul, German University, Prague, II/52.

DEUTSCHE RÖNTGEN-GESELLSCHAFT (GESELLSCHAFT FÜR RÖNTGENKUNDE UND STRAHLENFORSCHUNG)
Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.
Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.
Next meeting with the Gesellschaft deutscher Naturforscher und Aerzte will be in Hamburg, Sept 16–21, 1928.

SUD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.

NORD- UND OSTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA
Secretary, Professor M. Ponzio, University of Turin, Turin.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs S. A. Reinberg and S. G. Simonson.
Meets annually.
Sixth Annual Meeting, 1929, to be announced.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. A. Elektorowicz, 19 Hoza St., Warsaw.
Meets annually.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. B. Krynski, 11 Zielna St.
Meets once a month except in the summertime.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
Secretary, Dr. H. Scheuermann, Copenhagen
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY
Secretary, Professor Holzknecht, Vienna, IX, General Hospital.
Meets on the first Tuesday of each month from October to July.

## A NOTE ON ROENTGEN RAYS, CASTRATION AND ABNORMALITIES

In the July, 1927, issue of this Journal, Dr. M. R. Robinson has published an article on "The Effect of a Castration Dose of Roentgen Rays upon the Rabbit Ovary—An Experimental Study with a Clinical Evaluation of the Problem of Ovarian Irradiation."

There is no object at present in entering into a detailed criticism of many points which it includes. There are, however, in addition to those which I recently[1] pointed out, certain other matters which are apt to be misleading unless corrected.

Thus on page 2, Robinson lists the "factors which enter into a roentgen

[1] Little, C. C. Agents modifying the germ plasm. *Surg., Gynec. & Obst.*, January, 1928, xlvi, 155–159.

biologic experiment." These are: (1) Age of subject; (2) health; (3) functional state of organ or tissue at time of exposure; (4) interval between irradiation and removal of tissue, and (5) dose of radiant energy used. It is worth noting that this somewhat remarkable list of biologic factors makes absolutely no mention of genetic constitution or sex of the individual. Either of these two factors alone could, under certain circumstances, upset or disrupt the entire experiment.

On page 14 a statement is found to the effect that "the return of ovulation and menstruation after roentgen castration must be due to a ripening of primary follicles, *which were not affected by the irradiation** . . . " The italicized portion of this statement represents an utterly unscientific and illogical conclusion. What evidence exists that an ovary, the structure and activity of which, Robinson himself states, "are forever in a state of flux, either in the ascending or descending scale," would not liberate ova slightly harmed but not killed? There is no logical reason why it should not do so and many why it should. There are also steadily increasing numbers of biological experiments to show that damaged ova may be and *are* liberated, and that they give rise to lines of descent in which a large number of abnormal individuals are obtained. The recent prize paper of the American Association for the Advancement of Science was by Muller on just this topic. To be sure, he used insect material, but the, genetic nature of the abnormalities obtained by him suggest that the principle may well apply to mammals and man. It should be noted that evidence of a score of cases of no such observable abnormalities in the direct progeny of treated animals would not mean that later generations of their progeny might not be abnormal or that they themselves were not transmitting damaged germ cells to their descendants.

Robinson's erroneous views on this matter are repeated on page 19 where in commenting on the work of Nürnberger and Schinz, he states that irradiation of ovaries during pregnancy may kill embryos "and if the dose of the radiant energy used is not of sufficient intensity to destroy the products of conception, then the pregnancy may go to term, and normal offspring will be born." There can be under the inherent nature of the situation no assurance that this will be the case.

One might go on with a considerable number of such instances, but in view of the fundamental weakness of the reasoning shown by Robinson in those cited it would seem unnecessary. Only two other items will be mentioned.

In commenting on some work which I did with Dr. Bagg, Dr. Robinson states (p. 19) "that Nürnberger's observations are far more extensive . . . for they include 104 offspring of the second generation, and 14 of the third . . . " It should be noted that in two previous papers[1,2] evidence was given which showed that a total of 19 $F_2$ and 354 $F_3$ animals were then recorded. This gives a total of 373 animals in these two generations against 118 reported by Nürnberger. Besides these animals, I have raised in the laboratory since then more than 3000 of the particular stocks in question. They are now in their eighteenth generation, $F_{18}$, giving just as marked abnormalities as they did in $F_3$.

The last item has a touch of humor. It occurs at the point where on page 18 he is considering the size and weight of mice in relation to dosage. He mentions a "white mouse of an average weight of 95 gm." and bases his calculation upon that figure. Now unless a mouse is treated liberally as was the famous "Jumping Frog" of Mark Twain, he will not in one case in hundreds attain the weight of 65 or 70 grams. The picture of such a Gargantuan creature as the 95 gram mouse, is amusing if one has seen a 60 gram individual laboring under an obesity which is so abnormal as to form an object of physio-pathological investigation. Dr. Robinson may and undoubtedly does know the eight rabbits which formed the basis of his experimental results, but familiarity with mice would have helped the conclusiveness of his paper.

In dealing with a widely used and

* Italics mine.

[1] Little, C. C., and Bagg, H. J. The occurrence of two heritable types of abnormality among the descendants of x-rayed mice. Am. J. Roentgenol. & Rad. Therapy, 1923, x, 975–989.

[2] *J. Exper. Zool.*, 1924, xli, 45–91.

highly effective therapeutic agent such as roentgen rays, accuracy and high standards of experimental scientific methods are absolutely essential.

C. C. Little, D.SC.
University of Michigan,
Ann Arbor, Mich.

## A REPLY TO DR. C. C. LITTLE'S CRITICISM OF MY ARTICLE "THE EFFECT OF A CASTRATION DOSE OF ROENTGEN RAYS UPON THE RABBIT OVARY"

The two fundamental principles upon which a comparative roentgen-biologic study must be based, in order to claim any clinical validity, are: (1) That the test object must stand in as close a biologic sequence to the human species as possible; it must at least be a warm-blooded animal, and (2) that the experimental conditions must be equal to those which obtain during the administration of a certain therapeutic dose of roentgen or radium energy. In both these basic principles the experiments of Little, and of those biologists whom he quotes, are lacking. We cannot transfer experimental results obtained in toads, frogs and insects, irradiated under totally different conditions, with different doses, to the human species, without taking into consideration the differences in the physical conditions of the experiment, as well as the wide biologic chasm that separates these species in the scale of evolution.

As a striking illustration are the experiments of the Hertwig family, which form the peg upon which Little hangs his theory of the transmission of hereditary defects to the offspring of irradiated human females. But were not these experiments carried out on the sperm cells and eggs of toads and frogs irradiated outside the body, with very small doses of radiant energy? Does Little not know that there is a vast difference between irradiation results in tissues and organs when irradiated *in situ*, and when outside the body? Even the experiments of Muller, whom Little quoted in order to bolster up his theory cannot fit in in the scheme of the problem under consideration. Little's quotation reads: "To be sure, he [Muller] used insect material, but the genetic nature of the abnormalities obtained by him suggest that the principle may well apply to mammals and man." The same biologic absurdity repeated. I do not question the truth and the correctness of Little's or Muller's experiments, but they are different from mine. My experiments were upon warm-blooded animals, irradiated under conditions exactly the same as those clinically established during an ovarian castration in a human female.

In my first contribution[1] I laid stress upon this fact, and pointed out that the experimental results obtained by Little and other biologists cannot have a clinical bearing upon the problem of ovarian castration, because their experiments had totally different physical and biologic factors. For example, one of the differences was the proportional relationship of the irradiation field to the body surface, and I have pointed out that if Little's experiments were to have any clinical merit, his irradiation field for the white mouse should have been 2.5 sq. cm., instead of one-half of the body surface. No biologist could fail to admit that there must be a difference in the irradiation results when the fields of exposure are so varied in their size. I have cited the formula of Landois-Rosemann, which has very recently been used also by Teschendorf[2] and in the process of calculation or perhaps as a mistake in printing, the weight for a white mouse was erroneously put down as 95 gm., which should have been 15 gm.

Instead of heeding this biologic principle, Little resorts to buffoonery, and questions my scientific fitness to grapple with such problems. If Little had used a little more light, and a little less heat in his approach to this criticism, he would have been convinced that I never could have gotten 2.5 cm., as my factor, if I had used 95 gm. as one of the factors of the equation. This mistake cannot invalidate the importance and scientific value of this formula. The

[1] Robinson, M. R. The effect of a castration dose of roentgen rays upon the rabbit ovary. Am. J. Roentgenol. & Rad. Therapy, 1927, xviii, 1–25.

[2] Teschendorf W. Über Bestrahlung des ganzen menschlichen Korpers bei Blutkrankheiten. *Strahlentherapie*, 1927, xxvi, 720–728.

white mice in New York, weigh on the average 15 gm., the same as they do in Ann Arbor, and this secret is revealed to gynecologists as well as to non-medical scientists.

Furthermore, if Little needs further conviction as to the proportional relationship between the portal of entry and the body surface in irradiation problems, I refer him to the very valuable contribution by a very scientific clinician, Holfelder.[1]

Passing on now to the glaring defects in my contribution, to which Little points with so much superiority, I wish to reply as follows:

A. I did not mention the "sex of the individual," and the "genetic constitution" among the factors which enter into a roentgen-biologic experiment, for the following reasons:

(*a*) Would it not be absurd to mention the "sex of the individual" when the experiment is carried out with females. I am quite sure that there were no hermaphrodites among my specimens.

(*b*) "Genetic constitution"—I omitted this high-sounding phrase from the list of factors which enter into a roentgen-biologic experiment because thus far we can think of "constitution" only as of a concept, a philosophy, and not as a definite scientific entity. For more than twenty years an acrimonious battle has raged in the biologic world, as to what we really know and understand by the terms "constitution" and "constitutionality." There are as many theories as the number of disputants. This indicates that we are as yet dealing with something that is outside the limits of the knowable, and which is thus far solved only by logical considerations. As soon as Little is able to tell the scientific world how to recognize and estimate the nature and extent of the rôle which the endogenous (unchangeable) and the exogenous (variable) factors that enter into the composition of an individual being, play in his development, formation, and later reactions to environment, so soon will I include "genetic constitution" in the list of biologic factors that must be reckoned with in a roentgen-biologic problem.

[1] Holfelder, H. Kritische Ubersicht über die Grundlagen der Modernen Röntgentherapie. *Beibefte z. med. Klin.*, 1926, xxii, Heft 7.

B. My statement that "the return of ovulation and menstruation after roentgen castration must be due to the ripening of primary follicles which were not affected by the irradiation" is considered by Little as unscientific and illogical. His denunciation is based once more upon his experiments, which as I have already stated have no scientific bearing upon the problem under discussion. My assertion regarding the return of ovarian function is substantiated by histopathologic studies of irradiated ovaries, which show beyond the shadow of a doubt, that the three types of follicles have a different radiosensitiveness when exposed to the same dose of radiant energy. No investigator who has pursued this line of research can deny this fact. The microscopic sections of the ovaries removed at varying intervals after an irradiation with a castration dose, furnish undeniable proof of the correctness of this assertion. The structural changes that take place in the ovary after an exposure to a castration dose of roentgen rays are identical with the phenomena observed in the sex gland during the pregravid and menstrual states; its functions must therefore follow a corresponding course, and so they do.

With the gradual destruction of the tertiary follicles by the roentgen rays, the interstitial gland substance (which is the analogue of the corpus luteum) becomes the predominant constituent of the intergenerative element, and the primary follicles disappear from the cortical portion of ovary; and as the effect of the absorbed radiant energy is dissipated, the interstitial gland involutes, follicles begin to ripen, and the ovarian cortex is once more studded with primary follicles. This is an exact replica of the natural changes that go on in the ovary during the procreative life of the woman. And just as the temporary disappearance, or rather displacement, of the primary follicles in the pregravid or gravid states, and their functional inhibition at these periods, does not imply a destruction of the primary follicles, but a temporary abeyance, due to the internal secretions of the impregnated ovule and the corpus luteum, so does their structural displacement, and

functional suspension after a roentgen induced castration depend upon the presence and marked preponderance of the interstitial gland, brought about by the primary effect of the radiant energy, which hastens the maturation of ripening Graafian follicles, before their ultimate destruction, which is the sequence to an excessive stimulation. And just as the return of follicular activity after an ovulating or gestation period, is a normal physiologic process, so is the resumption of this function after a roentgen induced sterility also normal.

It is quite possible that with the employment of very small doses of radiant energy, the tertiary follicles may be harmed so slightly as not to interfere with their conceptive properties, and thus contribute damaged chromosomes to the future being; or that with the employment of dosage far in excess of the castration dose, the primary follicles may also be affected. But my experiments do not fall within this category; I am concerned with the problem of a castration dose, and no other, and unless investigators will confine themselves to this fact, and carry out their experiments along the lines delineated in this work, their conclusions concerning the effect of ovarian castration upon the offspring must remain questionable and unproven.

c. My "erroneous view" concerning irradiations during pregnancy, that "if the dose of radiant energy employed is not sufficient to destroy the ovum, the pregnancy may go on to term, and a normal offspring will be born," relates to irradiations after the first four months of gestation. This statement is backed by histopathologic, biologic, and clinical facts which I have succintly stated in my first contribution, and need not be repeated again. I only wish to restate one clinical fact, and that is, that the children born to mothers irradiated during the latter half of pregnancy were all normal, and this is an incontrovertible truth.

In order to protect the offspring from any malformations that may accrue to it from ovarian irradiation, I have warned *against ovarian or uterine irradiation after conception or during the first trimester of pregnancy*. The reason for this admonition is the well-known and accepted biologic law that the susceptibility of tissues and organs to irradiation effects is proportional to the state of their kinetic activity. Since the embryo constitutes a center of greatest kinetic unrest, its susceptibility is extreme; it may even exceed that of the follicle in a state of relative potential rest. This important conservative clinical postulate, Little chose to ignore.

d. In an article entitled "Agents Modifying the Germ Plasm[1] Little had the temerity to state: "The use of radiotherapy is increasing and its rewards are lucrative. Whole journals are partisan enough to concentrate on that particular field and results which are contrary to the popular desire—that such agents be considered mild and safe—are therefore not apt to be enthusiastically received." I consider this audacious utterance as a malevolent and libelous aspersion upon the medical profession; it should not go unanswered. No one who is acquainted with the march of medical progress will dare say that the leaders of American and European seats of medical learning advocate radiotherapy because of monetary motives. Research workers and scientists who contribute to medical progress ought to know that unless their theories can be tested in the crucible of clinical experience and found true, they will be relegated to the graveyard of dead and dying concepts and notions. The clinician, and not the laboratory worker, is the first and the last judge to properly evaluate the merits of a scientific contribution to medicine.

M. R. Robinson, M.D.
New York City.

## ROENTGENOGRAMS OF THE ANTRUM

*To the Editor:*

I enclose herewith skiagrams taken of the region of the antra of the same subject, one sitting up in the upright position and the other lying prone, both taken with the aid of the Potter-Bucky diaphragm.

The former shows clearly and unmistakably the fluid at different levels in each

[1] Little, C. C. *Surg., Gynec. & Obst.*, 1928, xlvi, 155–158.

antrum, whilst the latter shows merely a diffuse and uneven density on each side.

As Dr. K. Cross has demonstrated so clearly the marked advantage of taking

FIG. 1. Erect posture.

FIG. 2. Prone posture.

skiagrams of the antrum in the erect posture, apart from calling attention to the special advantage of this method, I must refer readers to the original, namely, the *Medical Journal of Australia*, October 22, 1927, for details, of this procedure.

Yours faithfully,

H. FLECKER.

Melbourne,
Australia.

## CHICAGO ROENTGEN SOCIETY

At the recent meeting of the Chicago Roentgen Society, Dr. Robert A. Arens, Michael Reese Hospital, was elected president, and Dr. W. T. Bronson, Englewood Hospital, was elected secretary.

## INDIANA ROENTGEN SOCIETY

A meeting of the Indiana Roentgen Society was held in Terre Haute on May 23, 1928. The membership of this Society now numbers thirty-six roentgenologists from various parts of Indiana. The guest of honor was Dr. Edwin C. Ernst of St. Louis, the president of the Radiological Society of North America, who gave a talk on the subject of "Malignancy." The next meeting of the Society will be in Indianapolis, February, 1929.

## NEW ENGLAND ROENTGEN RAY SOCIETY

At the annual meeting of the New England Roentgen Ray Society held in Worcester on June 6, 1928, Dr. F. B. Lamb of Portland, Maine, was elected president, Dr. A. S. MacMillan of Boston, vice-president, Dr. John D. Camp of Boston, secretary-treasurer, and Dr. M. C. Sosman of Boston a member of the Executive Committee.

The secretary reported that eight meetings had been held during the year, three at the Boston Medical Library, and one each at the University Club, the Massachusetts Eye and Ear Hospital, Children's Hospital, Peter Bent Brigham Hospital, and one in Worcester, Mass. Seven new members were accepted during the year, and one member died, Dr. A. P. Merrill of Pittsfield, Mass. There are one hundred and twenty members at present in the Society.

# DEPARTMENT OF TECHNIQUE

*Department Editor:* DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

*In this department will be published from time to time, as material is available, suggestions for improvement in technique.*

## A ROUTINE STEREOROENTGENOGRAPHIC TECHNIQUE, IN TWO OR MORE PLANES, FOR SIMULTANEOUS VIEWING; INCLUDING THE STUDY OF THE MASTOID PROCESS*

BY DAVID R. BOWEN, M.D., AND PAUL A. BISHOP, M.D.

Pennsylvania Hospital

PHILADELPHIA, PENNSYLVANIA

WHILE we may claim originality in this thesis, we may not claim priority. The basic idea was clearly stated by Hill and Thomas[1] in 1919, in a paper dealing solely with the mastoid process. We justify this presentation by the scanty circulation of their article, by its intrinsic value, by our own amplification of its uses and our special equipment for its technique.

In any examination or consideration of any subject it is desirable to have all the available data, arranged in the relation or sequence of greatest convenience. This is especially imperative in any roentgen study which depends upon the comparison of two or more postures. Hence, the broad illuminating boxes universally used.

The necessity for discarding, even for a moment, one of a series to take up its counterpart, to be unable to view the two or more side by side, is always a handicap. Yet, this is the routine practice when stereo studies in more than one plane have been made. This handicap is only partially removed by the use of revolving illuminating boxes on the stereoscope, though these do greatly improve the situation.

We propose here an arrangement of two or more stereo pairs in such a manner that the study of them may proceed without further manipulation. A special exposure technique permits this arrangement of two pairs upon two films rather than four, three pairs upon three films, etc.

One of us (Bowen) has, for fifteen years or more, used plate changers of various plate or film sizes for making the two stereo exposures on one plate or film. The clumsiness of these wood and lead contraptions led to the design of the present adjustable instrument (largely the work of Bishop) which accommodates all four of the possible stereo exposures of $8 \times 10''$ and $10 \times 12''$ films.

The present technique grew out of the use of this instrument, without previous knowledge of the antedating work of Hill and Thomas.

Hodges[2] has proposed a modification of Hill and Thomas' work using, however, a separate film for each image. The stereoscopic features of our mastoid technique do not differ in any essential detail from those of Hill and Thomas but the exposure, posture, and tube position features have not, we believe, been published heretofore.

The layout of the exposure technique must begin with a description of the special tunnel or film changer.

To a brass pan, measuring $18\frac{5}{8} \times 12\frac{3}{4}$ in. and $\frac{5}{8}$ in. deep (Fig. 1), open at the top and at one end, there is firmly screwed a solid bakelite top. Over this top and at the closed end of the pan there is fitted permanently a cover of hard rolled copper, $\frac{1}{8}$ in. thick and wide enough to cover 6 in. of film. To the opposite end is fitted a similar copper cover which is, however, movable, the excursion of 2 in. being limited by one bolt on each side which projects through a slot in the turned over edge of the movable copper cover. This

* Read at the Twenty-eighth Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Montreal, Canada, Sept. 20–23, 1927.

cover also carries on its surface a projecting pin or stop, $^{3}/_{16}$ in. long, which moves in a slot 2 in. long cut in the bakelite top and projects slightly down through it. The excursion of 2 in. is so set that the uncovered section of bakelite may be 4, 5 or 6 in.

The film is carried on a separate shallow brass pan with a projecting handle which is adjustable over the same range of 2 in. and carries an upward projecting pin or stop.

The first exposure in any case is made with the film in the same relative position, regardless of size; i.e., with the distal edge of the film meeting exactly the proximal edge of the fixed copper cover. If the exposures are to be two 6 × 10″ on one 10 × 12″ film, or two 4 × 10″ on one 8 × 10″ the film will, in either case, be stopped at this same position by a spring which engages a notch in the film carrier, and the width of the exposure will be determined by the position of the movable copper cover.

Because the pin projecting downward from this cover and the one upward from the film carrier handle move with these members, their engagement will accurately determine the second position.

## EXPOSURE TECHNIQUE

It is only necessary that the two images to be viewed by the right eye shall be upon one film and that the two for the left eye shall be upon another and that the images upon each film shall be in the proper sequence. Assuming that, we begin by making the left eye exposure of body posture No. 1 upon film No. 1; we then change films and the tube position and make the right eye exposure of the same body posture upon film No. 2. The distal half of each film has now been exposed.

The body part is now changed to posture No. 2 and the No. 2 film, which has not been removed from the tunnel, is pushed inward until the stops engage. This brings the unexposed proximal half of this film under the uncovered bakelite section and the right eye exposure of body posture No. 2 is made without relative change of tube position. This (No. 2) film now holds the right eye exposure of both body postures and is ready for development.

The examination may now be completed by shifting the tube to the first or left eye position, reinserting film No. 1 as far as the stops permit, thus bringing its unexposed proximal half under the unprotected bakelite section and making the left eye exposure of body posture No. 2. By this "firing order" the procedure is completed by three instead of four handlings of the films (Fig. 2). If this seems confusing it may be said that the order 1-2-3-4 can also be used. It means only one more handling of the film.

If we routinely insert the open, metal clipped end of the film holder first, no other precaution is needful to prevent duplication or double exposure.

If films so exposed are finished and placed in the stereoscope in the usual manner, stereoscopic images of both postures will appear side by side and may be studied alternately with no other physical effort than that of turning the eyes from one to the other.

This first model has no provision for screens. Another model* for this purpose is under construction but it must needs be considerably larger and heavier, and this original model will continue to be preferred for the exposure of small parts on films without the screen. Similarly the adaptation of this method to the Potter-Bucky diaphragm offers no other problem than the mere adjustment of measurements.

Stereo films so arranged are of immense advantage whenever coördinate study of anteroposterior and lateral or, in fact, any two positions, is to be made (Fig. 3). Among other situations in which its utility is easily appreciated is partial ankylosis of the elbow where lateral studies of the extreme possible flexion and extension can be so compared. In one exceedingly puzzling elbow case (Fig. 4) two flexoextensor postures, the extreme internal and external rotations, were easily viewed and their relations to the third or intermediate degree of rotation were

* This tunnel, having been completed, has a top measurement of $13^{3}/_{4}$ × $19^{1}/_{4}$″ and is $1^{1}/_{4}$″ deep. To avoid excessive weight, the bottom as well as the top has been made of bakelite.

studied. It is, of course, also feasible to arrange in the same order pairs which have been taken on separate films. It is needful, only, to have them in proper sequence, with left eye views and right eye views properly arranged. In earlier years we desired to do this and made repeated attempts but each time failed to make the proper reversal. The relations of the two or more pairs must be reversed in the same manner and for the same reason that the sides of single pairs are so reversed. We have recently seen Dr. Manges studying both sides of the head in this manner. To accomplish this it is necessary to confine the study to 8 × 10″ films and to make the tube shift in the vertical plane. Otherwise, the films could not be accommodated in present day stereo illuminating boxes. Once in hand, double or triple pairs can be arranged for view as either orthoscopic or pseudoscopic images, the only limit being the size of the available light boxes.

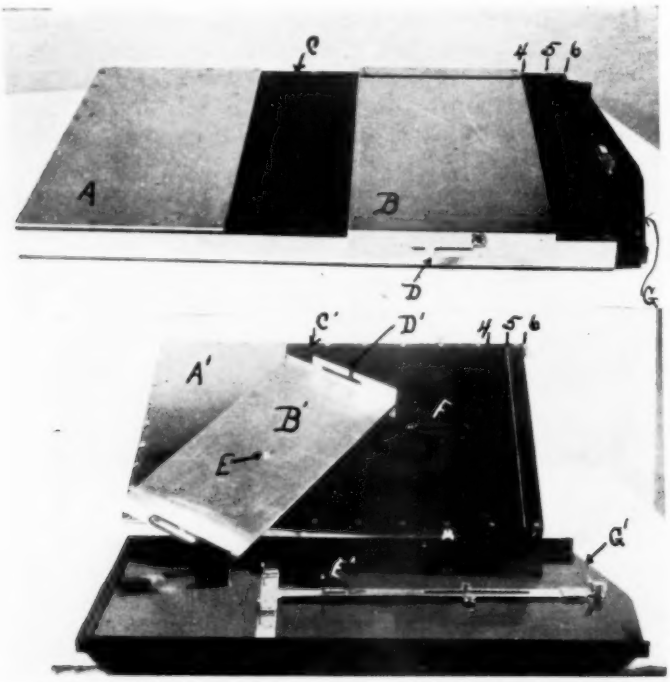


FIG. 1. Adjustable-cover stereo tunnel. A-A'. Solid copper cover rigidly fixed over bakelite top. B-B'. Movable copper cover having an excursion of 2 in. over bakelite top. C-C'. Bakelite top. E. Downward projecting pin which runs in slot, F, in bakelite cover and engages stop, E', on handle of carrier pan, G-G'. 4, 5, 6. Respective positions for cover, B, according as 4, 5, or 6 in space of bakelite top, C, is to be uncovered.

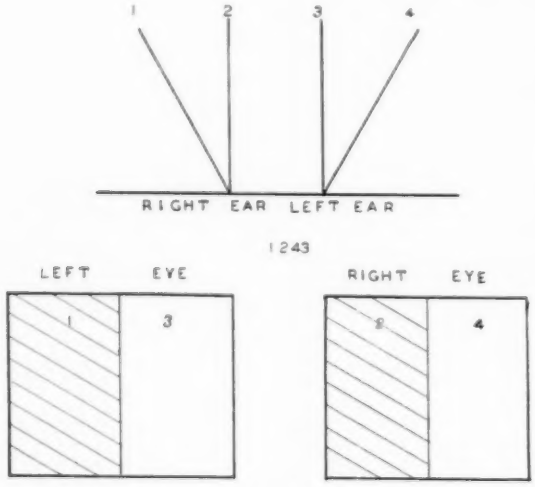


FIG. 2. Shows required sequence of exposures.

For the mastoid study we use another bakelite top tunnel (Fig. 5) made to hold 8 × 10″ cassettes. A space $\frac{3}{4}$ in. wide across the lower edge is protected by a lead strip,* this space being later used for

* In later practice we have used this lead strip at the top of the film instead of the bottom. In that position it is quite certain not to overlie any wanted detail.

number and legend. A reversible copper plate has been so fitted to this tunnel that pins on the under side of the plate

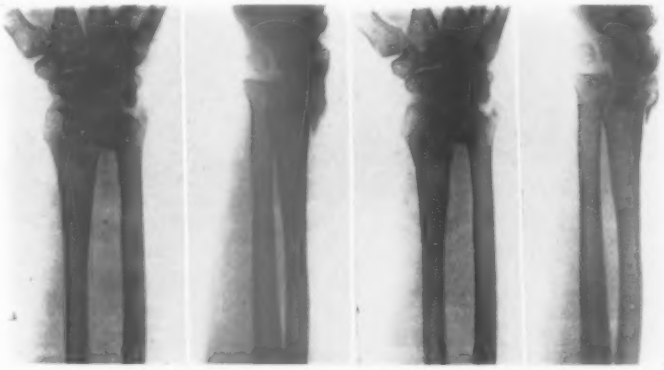

Fig. 3. Two-position stereoroentgenogram of Colles' fracture.

fit into drill holes on the top of the cassette. The plate may thus be used alternately to cover either side. On a line $1\frac{1}{2}$ in. from one edge of this plate we have fixed the nose rest from the Granger mastoid board. Thus, when we examine the left mastoid this nose rest will cover the right side of the cassette and $1\frac{1}{2}$ in. to the right of the median line. The term "left" refers to the patient's left ear and the term "right" to the patient's right hand. If the operator stands at the patient's head the cover and nose rest will be at his left hand.

In accord with Granger, we depend upon the position of the nose against the nasal rest to obtain and maintain the proper centering of the mastoid over the film, and we find that no other precaution is needed. Thus posed, the head is fixed usually by an arrangement of sand bags but occasionally by a compression band. The auricle is not folded forward.

Now, with the left ear toward the film (Fig. 6) the target is placed, by means of a centering rod, vertically over the right external auditory meatus. The target is set 24 in. above the film and from this point moved $\frac{1}{2}$ in. toward the top of the head and from this point tilted 20° toward the patient's feet—no tilt toward the right or left. In this modified Granger position the upward auditory meatus is, for all practical purposes, vertically over the downward meatus, i.e., the one approximating the film. A 5 in. cone is used and exposure No. 1 which will produce the *right* eye image of the *left* mastoid is made upon the *left* side of film No. 1.

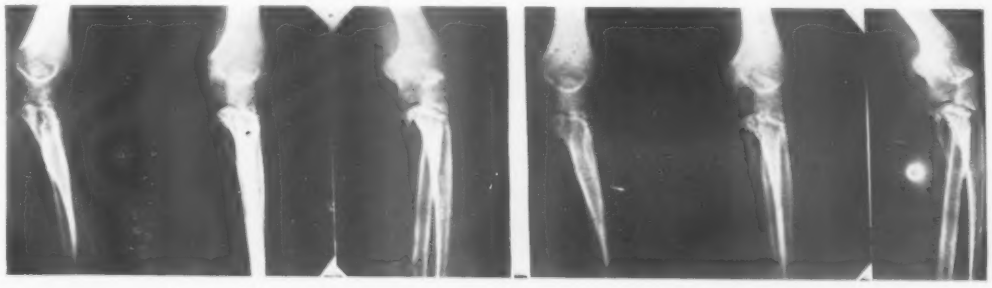

Fig. 4. Three-position stereoroentgenogram of old fracture of elbow.

Film No. 1 is now removed, a permanent mark is made on one corner of the cassette insuring the proper direction for its reinsertion, and film No. 2 is inserted in the same relative position. The target is then given the *entire* 6 cm. stereo shift *toward*

the *back* of the head. The 20° tilt in the vertical plane is not changed but another tilt of 8° toward the patient's nose is added. In this position exposure No. 2, which will produce the *left* eye image of the *left* mastoid upon the *left* side of film No. 2 is made. The head is now lifted and the copper cover adjusted to cover the *left* side of the tunnel, being at the same time reversed so that the nasal rest is in position $1\frac{1}{2}$ in. to the left of the median line. The head is again fixed, this time with the *right* ear resting over the *right* side of the tunnel, and the exposures made as for the left side.

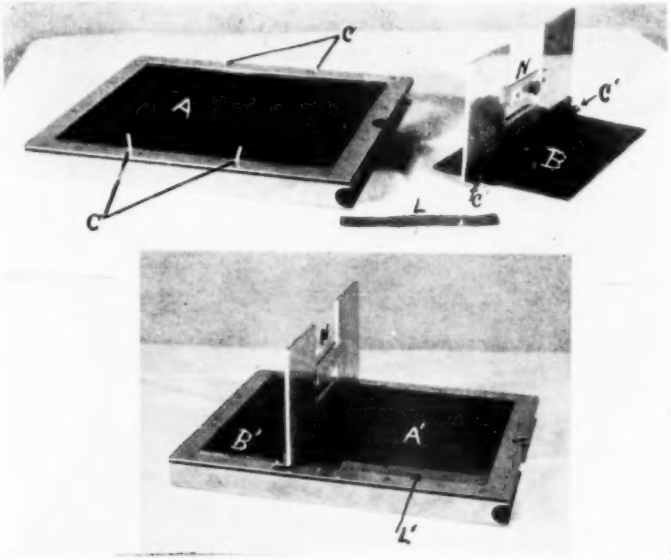


FIG. 5. Special stereo mastoid tunnel (available also as stereo tunnel using an entire (8 × 10) film for each exposure). A-A'. Bakelite cover. B-B'. Removable copper cover. (To this cover is permanently attached Granger's nasal rest, N.) C-C. Wooden pegs to indicate four drill holes which receive metal pin, C'-C'. (Plate B-B' is reversed from right to left or vice versa.)

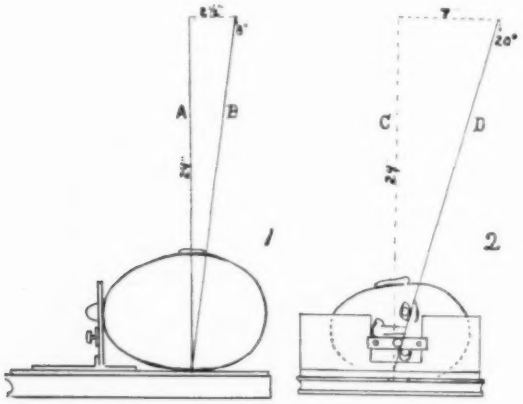


FIG. 6. Sketch of mastoid position and stereo shift. 1. Crown presenting. 2. Face presenting. A. First stereo position in the vertical plane of the auditory meatus. B. Second position, the tube being shifted $2\frac{1}{2}$ in. backward from the first position and tilted 8° forward (both positions are in plane D). C. Imaginary line vertical to the auditory meatus. D. Antero-posterior plane of the stereoscopic shift. The tube has been shifted 7 in. toward the crown of the head from imaginary line, C, and then tilted 20° toward that line.

In this instance the third exposure, which will produce the *left* eye image of the *right* mastoid, is made from the vertical position on the *right* half of film No. 2, which already carries on its *left* half the *left* eye image of the *left* mastoid. The fourth exposure, which will produce the *right* eye image of the *right* mastoid on film No. 1, is made from the posterior position.

The opaque covers are now removed from the tunnel and a larger, single cover substituted which covers all but the lower $\frac{3}{4} \times 10''$ strip of each film. In this area is placed the opaque letter legend R-L, serial number and date. The examination is completed by adding this to the lower edge of each film by separate soft exposures.

Despite the formidable character of

the description, the method, when followed routinely becomes very simple and the slight additional care is more than repaid by the satisfaction gained from the comparative study of both mastoids side by side before the eyes (Fig. 7).

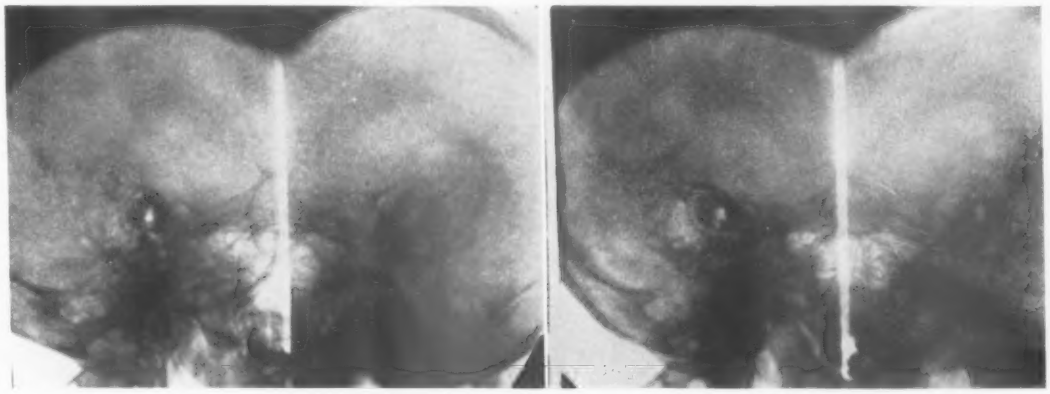

Fig. 7. Roentgenograms of both mastoids ready for viewing as one pair.

Our reason for preferring the, to some, peculiar modification of the usual tube shift is, first, that it gives one view of each mastoid in the vertical plane and that the other view is from a point quite posterior to this plane. If one position is half the shift forward the shadows of the middle ear always complicate those of the cell area, and the half shift backward is not enough to wholly clear this up. We have used this part of the routine for ten years or more and cannot say whether it is original. It is more than probable that it was arrived at jointly with Dr. Manges.

Also, we do not routinely fold the auricle forward, believing that the value of its shadow for orientation more than offsets any handicap from its shadow overlying that of the mastoid. Inasmuch as all studies are stereoscopic, this auricle shadow rarely concerns us. Very, very rarely we re-examine with the auricle forward for comparison.

This is by no means a complete mastoid study and is not so offered. A least seven distinct positions for the study of the mastoid area are offered and of these there are many minor modifications. And in doubtful cases the examination should be as complete as time and the condition of the patient will permit. Any of these postures may be used with advantage in some modification of the stereotechnique here presented. For instance, we may cite the Arcelin position as made with the use of Granger's rest (still attachable to our modification). In this case the entire stereo shift is away from the first vertical exposure.

## SUMMARY

Two or more stereoscopic pairs of roentgen films of a body part may be arranged for stereoscopic viewing, and then studied, with no more physical effort than that of shifting the vision from one to the other. This procedure is particularly desirable in the study of joint injury and the mastoid process.

A new instrument, film changing tunnel, is described; this for the convenient and accurate technique for these double stereoscopic studies.

A modification of classical positions for study of the mastoid process is offered.

The method includes an area around each mastoid sufficiently large to include all complicating lesions.

Finally, it may be said that the procedure here set forth is no small part of a general improvement in exposure routine by which, with a constantly increasing number of patients to examine, we have been able to gradually reduce our expenditure for roentgen films for a period of upward of two years. At the same time all of these studies have been more full and complete than formerly.

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2. HODGES, PAUL C. A new method of simultaneous stereoscopic observation of both mastoids. AM. J. ROENTGENOL., 1922, ix, 753–754.
3. GRANGER, AMEDEE. New device and technic for making radiographs of the mastoids in the Law and in the Arcelin positions. *Radiology*, 1925, v, 44–52.

# ROENTGEN PELVIMETRY AFTER THE THOMS METHOD WITH A SIMPLIFICATION OF TECHNIQUE

BY A. C. HEUBLEIN, M.D., D. J. ROBERTS, M.D., AND R. T. OGDEN, M.D.

HARTFORD, CONNECTICUT

ALMOST from the very discovery of roentgen rays attempts have been made to utilize them as a means of measuring the superior strait of the female pelvis. From the time of Fabre up to the present, various ingenious, complicated, mathematical methods have been introduced which give more or less accurate measurements, but which are too involved and in most cases too time-consuming for practical use.

As it was considered impossible to get the patient into a position so that the superior strait would be on a plane with the sensitive film, exposures were made in the prone, or recumbent, position thus causing an unequal distortion of the pelvic inlet. This unequal distortion resulted in mathematical formulae and equations for correction.

It remained for Thoms to demonstrate that the patient could be put into such a position that the superior strait would be on a parallel plane with the roentgen film and a satisfactory roentgenogram could be made showing the actual shape of the pelvic inlet, enlarged in proportion to the degree of divergence of the rays, but equally so in all directions. From this Thoms developed a "modus operandi" which we have adopted both in private work and at the Hartford Hospital, with modifications which have simplified the procedure for our use. Instead of a box frame together with a Bucky diaphragm on the floor we have devised a light frame with adjustable back rest, as seen in the diagram, which is placed at one end of our particular type of Bucky table and held in place by a cleat which extends over and under the table edge. Slight variations may be necessary for other types of tables.

The patient is seated upon the end of the table in a semi-recumbent position with the feet resting on a chair or stool, the back arched and resting against the back rest. The Bucky is brought forward and adjusted beneath her. To make the superior strait parallel with the film an anterior point is taken just below the upper margin of the symphysis pubis, and a posterior point near the upper apex of Michaelis' rhomboid, which is a four-sided space formed by the transverse, sacrospinalis and gluteus muscles. A point approximately 2.5 cm. above an imaginary line drawn between the depressions marking the attachment of the fascia to the posterior superior iliac spines, will designate a position at the upper apex of Michaelis' rhomboid which will be approximately on a plane with the superior strait. The patient is so manipulated that these two points are an equal distance from the top of the table and this measurement taken with calipers. To avoid unequal distortion the tube must be accurately centered over the pelvic inlet and a central point 5 cm. behind the symphysis pubis is taken.

Adequate exposure is made and the patient removed. Then, with no change made in the position or distance of the tube, a sheet of lead the size of the film, with a row of small holes exactly 1 cm.

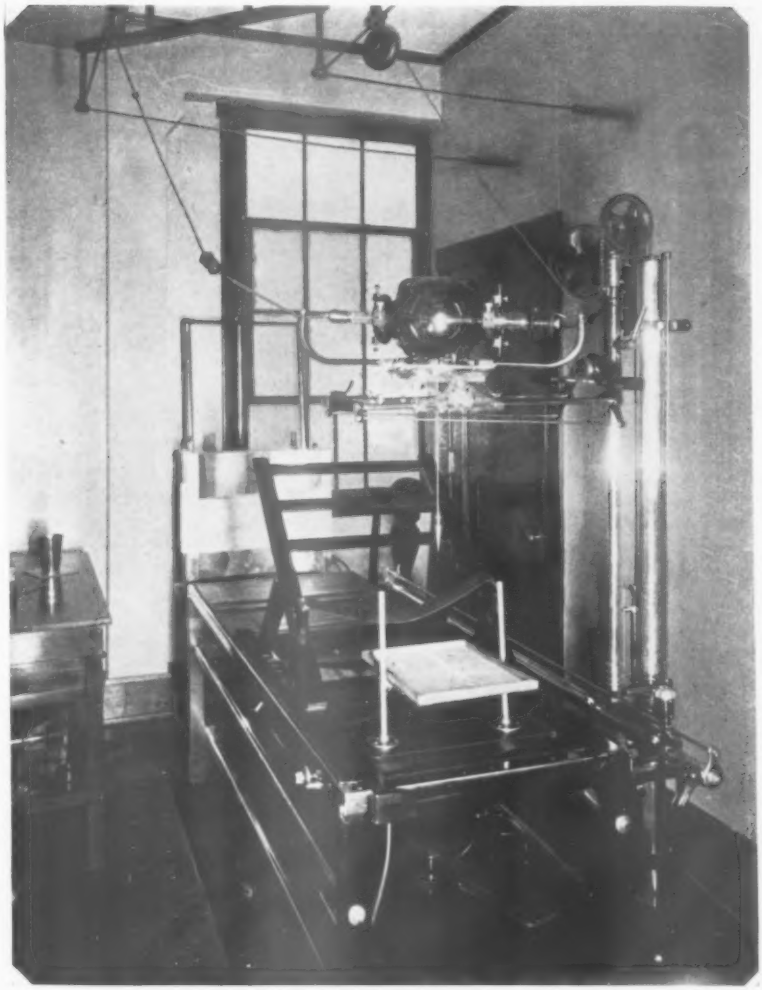

FIG. 1. Shows both the supporting frame and adjustable measuring scale.

apart running through the center, is arranged under the tube by appropriate holders in the same plane previously occupied by the superior strait, thus bringing the lead plate the same distance from the table as the measurement previously taken. With the lead strip centered in position a flash exposure is made superimposing a row of small holes, comparable to 1 cm. apart, across the anteroposterior diameter of the pelvic inlet. The film is then developed.

Since the superior strait and the lead plate with its centimeter scale are exposed at the same distance from the film they are both distorted equally, and with a pair of calipers any of the diameters of the superior strait, oblique, transverse, or anteroposterior can be taken and read directly in centimeters upon the superimposed scale.

This is a simple, accurate and practical method for obtaining both the size and shape of the pelvic inlet and gives very satisfactory results when combined with the lateral examination. The advantages of the modification are that the Bucky diaphragm is incorporated in the table, that the frame not only is applicable to this table but is light and easy to handle, occupies very little space, and when not in use can be hung on the wall. The back rest is adjustable, with a projecting support for the small of the back, thus aiding the patient to maintain the arched position.

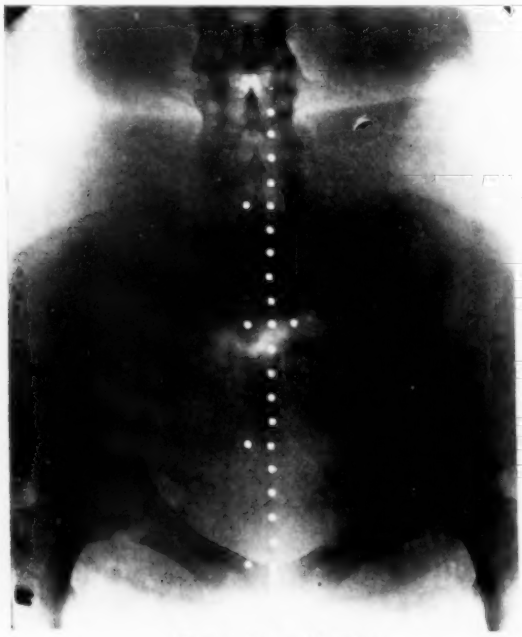

FIG. 2. Normal pelvis.

FIG. 3. Lateral of normal pelvis.

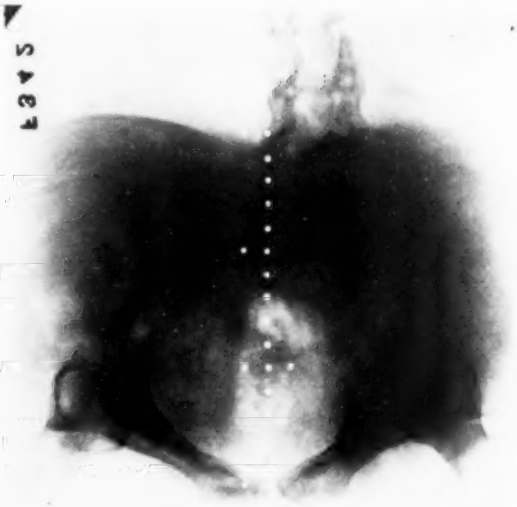

FIG. 4. Contracted rachitic pelvis.

FIG. 5. Lateral of Figure 4 showing a convex sacrum.

# BOOK REVIEWS

*Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.*

Handbuch der Lichttherapie. By W. Hausmann and R. Volk. Paper, price 36 RM.; bound, price, 38 RM. Pp. 444, with 106 illustrations and 36 tables in the text. Wien: Julius Springer, 1927.

This book is written as an introduction to the theoretical and practical principles of light therapy. Fifteen authors have combined their efforts in outlining the present status of this relatively new branch of medicine. It is divided into a general and a special part. The first part contains chapters on the historical development of light therapy (O. Bernhard), physics of the sun and sky-radiation (F. M. Exner), artificial sources of light (F. Hauer), measuring methods of light in the ultraviolet region (F. Hauer), general principles of light therapy (W. Hausmann), morphological changes of normal and diseased tissue due to light exposure (G. Politzer), general remarks on light therapy and on the application of apparatus used in light therapy (O. Strandberg). The special part deals with heliotherapy in surgical diseases (O. Bernhard), the treatment of surgical diseases with artificial light (O. Chievitz), light therapy in pediatrics and prophylactic light treatments (K. Huldschinsky), light therapy in gynecological cases (E. Lang), light therapy in internal medicine (A. Laqueur), light therapy in tuberculosis of the lungs (J. Sorgo), the quartz mercury vapor lamp as a therapeutic agent in surgery (L. Schönbauer), the application of light in laryngology, rhinology, and otology (O. Strandberg), light therapy of the eye (J. Urbanek), light therapy of the skin and venereal diseases (R. Volk), the treatment of smallpox by light starvation (C. H. Würtzen).

The contributions of Hausmann and Huldschinsky are very well done; quite interesting is the article by Politzer who has carried out considerable research on the effect of light on tissue. Strandberg's chapter on general light therapy gives an excellent review of the subject which is of course influenced by the Finsen School. Many readers will be satisfied to have Bernhard present his ideas on the heliotherapy of surgical tuberculosis because there is no doubt that he is considered a pioneer in this particular field. The indications for the treatment of pulmonary tuberculosis are drawn by Sorgo in a conservative manner; perhaps not conservative enough for some clinicians. This problem, however, is still much discussed and opinions differ. It would be desirable to bring the article on dosimetry up to date; some of the important recent advances are not even mentioned.

The presentation of the subject by a number of authors permits naturally a comparison of the different schools. This advantage is somewhat counterbalanced by unavoidable repetitions. The general practitioner and the beginner will read the book with profit; the advanced student might look for a more complete presentation, particularly for a critical discussion of the enormous literature in this field.

E. A. Pohle.

La Radiographie en Gynecologie, en Obstetrique et en Urologie. (Roentgenology in Gynecology, Obstetrics, and Urology.) By Dr. Carlos Heuser, Buenos Aires, Associate Physician to the Hospital Alvear; Ex-Chief of Service of the Hospital N. de A. Pp. 194. Buenos Aires: Published by the author, 1926.

This is a beautifully printed book, gotten out in special binding. The original was published in Spanish; but in order to give it a wider distribution, the author translated it into French. The printing has been done on paper of exquisite fineness and all the illustrations are actual photographs, which are inserted as regular pages, the printing having been done on the backs of the photographs.

This volume was sent to the undersigned asking that it be exhibited before the American Roentgen Ray Society with the greetings of the author to all his North American colleagues. The work records Dr. Heuser's experience in the use of the roentgen rays in gynecology, obstetrics and urology, especially aided by the introduction of pneumoperitoneum and opaque substances, such as lipiodol, and the Potter-Bucky diaphragm. Dr. Heuser, in 1922, encouraged by the good results of his bronchial injections of lipiodol according to the method of Sicard and Forestier, practised a similar method to obtain roentgenograms of the uterine cavity and the tubes. He presented reports on this work at the Third Pan American Scientific Congress at Lima in 1924, the German Radiological Congress and the Society of Radiology of Paris, in 1925, and at the International Congress of

Radiology in July of that same year. Dr. Heuser had previously done work with colargol in the bladder in 1912, and at that time had tried to obtain roentgenograms of the uterine cavity. He found that the various opaque substances which he and others had tried prior to the introduction of lipiodol had caused peritoneal reactions which were unpleasant; but with lipiodol, he declares these unpleasant sequelae no longer are encountered, and he is now enabled to study the permeability of the tubes as well as their deformities, the uterine cavity, internal tumors, and pregnancy as early as the second week.

The work includes a discussion of the various methods of roentgenographic examination in these three specialties: (1) visualization of uterine cavity as well as of the tubes; (2) recognition of the different intrinsic disturbances of the different uterine mucosa (polypi, intrauterine fibroids, etc.); (3) differential diagnosis between fibroid tumors and pregnancy; (4) sterility from various causes; (5) development of the fetus during the period of pregnancy, whether intra- or extra-uterine; (6) diagnosis of malformation of the fetus; (7) diagnosis of death of fetus; (8) roentgenographic diagnosis of the various affections of the urinary tract; (9) a roentgenographic demonstration of the mucosal wall of the bladder by the method of impregnation with lipiodol, to recognize polypi, fibromas, ulcers, etc.; (10) the diagnosis of bone syphilis by a special sign of Dr. Heuser.

A discussion of bone syphilis occurs in the chapter on roentgenography of the urinary bladder, in differentiating between syphilitic and other disease of the bladder. In syphilis of the bladder, there are found bony metastases which are not seen in cancer of the bladder. These syphilitic metastases are small rugosities of one or more millimeters in height, seen in various portions of the innominate bone. In these bones there are rugosities on both sides which involve the bone symmetrically as well as in the sacroiliac and coxofemoral articulation, and in the coxofemoral articulation, generally occupying the lower part of the joint in the border of the joint cavity. These should call attention to the probability of syphilis rather than a tumor of some other nature when we are studying the bladder.

This work is an elaborate testimonial of the vigorous interest maintained in advanced roentgenology by our South American colleagues and of the high standard of roentgenographic technique maintained by them.

James T. Case.

# INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

## ROENTGEN DIAGNOSIS

ARNELL, SIGFRID. Annular shadows in the lungs caused by subpleural emphysema. *Acta radiol.*, 1927, viii, 252–256.

A report is given of a case occurring in a laborer aged thirty-eight. The roentgen picture of the lungs showed annular shadows, and the postmortem examination confirmed the diagnosis of emphysemal blisters. There were a great number of subpleural blebs varying in size from that of a pea to that of a hen's egg. The author believes that this is probably the first case in which the postmortem examination has confirmed the roentgenological diagnosis of emphysemal blisters as the cause of the annular shadows.

ARNELL, SIGFRID. A case of acranion and hydramnion diagnosed before birth. *Acta radiol.*, 1927, viii, 257–258.

It is seldom that acranion in the fetus is diagnosed before birth. The author describes a case in which roentgenograms demonstrated the existence of acranion. That it was also a case of hydramnion was deduced from the fact that the fetus was small in proportion to the circumference of the mother and partly from the fact that the fetus kept changing its position in the course of the examination. Roentgenograms showed the subcutaneous fat clearly visible against the hydramnion fluid and also the musculature of the fetus.

ARNELL, SIGFRID. Two cases of Hodgkin's disease with bone destruction. *Acta radiol.*, 1927, viii, 259–262.

The first case occurred in a farmer, aged fifty, and the second in a laborer, aged twenty-two. In both cases the roentgenological picture of bone infiltrated by lymphoblastoma tissue resembled that of bone infiltrated by malignant neoplastic tissue. So far as can be seen, there is nothing really definite in the roentgenological picture to distinguish the two conditions from each other. The final diagnosis will have to rest upon the clinical examination and on the biopsy. The localization of Hodgkin's disease to bone is probably not so infrequent as may be supposed. One should always bear Hodgkin's disease in mind when there is a roentgenological evidence of bone tumor of malignant type.

D'AMATO, GIUSEPPE. The roentgen picture in arthrochondromatosis. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 730–735.

Two cases of chondroma of the joint are described, one of which was diagnosed before it had become well advanced. The disease is not as uncommon as is usually supposed, but it is not often recognized and it seems to be confused with arthritis deformans. This confusion seems peculiar when one considers the fact that the absence or insignificance of the osteophytic points which may be found even in the most advanced and extensive conditions represent a characteristic of the disease picture. The disease process consists of chondromas arising in the synovia and growing out into the joint cavities. Diagnosis is made primarily from the roentgen finding which shows smaller or larger tumors very distinctly visible because of their lime content or ossifying processes. The first case occurred in a man aged sixty who had an involvement of the knee. The second case occurred in a man aged thirty-six with a similar involvement of the elbow. The patients were both in fairly good physical condition and the disease occurred in only one joint.

FLEISCHNER, FELIX. The lung apex in the roentgenogram. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 749–755.

The observation of calcification of the apical pleura confirms the dictum that the "accompanying shadow of the second rib" represents the upper pulmonary boundary (Assmann). Even with normal appearance of the accompanying shadow pleuritic changes cannot be excluded. Irregular or obscure outline of the accompanying shadow is a sign of some involvement of the apical pleura, combined with a condensation of the immediately adjacent pulmonary parenchyma: induration of the apex.

A considerable asymmetric position of the upper pulmonary boundary in an otherwise normal picture indicates an apical pleural induration or an effusion surrounding the pulmonary apex. These pleural thickenings and apical indurations are closed, latent or at the most slowly progressing processes. They have nothing to do with the more extensive parenchymal diseases of the pulmonary apex. Above all, they should not be confused as

apicitis with early true tuberculosis which never has its beginning in the extreme apex. The current explanation is that with a free effusion the veiling of the apex in the roentgenogram and the dullness of the apex on percussion is due to atelectasis of the pulmonary apex; but it is shown that very frequently a free effusion produces a thin mantle reaching to the apex which quite simply explains the observations made in the roentgenogram and on percussion of the apex.

Hager, Benjamin H., and Braasch, William F. Cystography. *Surg., Gynec. & Obst.*, 1927, xlv, 502–511.

Cystography is not intended to replace ocular inspection of the bladder but to corroborate cystoscopic findings. It may be of considerable value in ascertaining the presence of bladder lesions when the general condition of the patient or technical difficulties preclude cystoscopy. Cystography affords a means whereby diverticulum of the bladder may be recognized and also furnishes information as to the capacity and ability of the bladder to empty. In cases of vesical neoplasm cystography may portray the site and extent of the malignancy and determine the advisability of operative procedure.

Lesions of the bladder secondary to cord changes may be recognized by characteristic variations in outline together with evidence of regurgitation of contrast medium into the ureter and urethra. Various deformities of the bladder occurring with hypertrophy of the prostate have been noted. The importance of cystography in infants with persistent pyuria is emphasized because of its value in determining the presence of atony of the urinary tract with the resultant ureterectasis and pyelectasis. Deformity of the bladder from extravesical pressure may be recognized in the cystogram, the outline of which is usually regular in contrast to the more irregular filling defect caused by neoplasm.

The following technique has given satisfactory results. Simple roentgenograms of the bladder area are made prior to cystography in all cases. Three film exposures are taken to aid in the identification of the bladder lesions. The first two films are made with the bladder fully distended with 5 per cent emulsion of the silver iodide and the urethral catheter withdrawn. The patient is placed in the reverse Trendelenburg position with the table at an angle of 10° toward the foot. The Coolidge tube is placed at an angle of 5°, which makes a total of 15° inclination toward the foot. The tube is also tilted at an angle of 8° to each side in order to secure lateral exposures. The two lateral views at opposite angles appear to portray more clearly the position of diverticula and defects. When the bladder is emptied preparatory to taking the third film, no pressure is exerted. It is safer to rely on catheterization to remove the contents of the bladder than on the patient's efforts. The third film is made in the anteroposterior position without any lateral angulation of the tube but with the same 15° tilt toward the foot. At no time is compression to be made with the cone.

Hanson, Robert. Destructive non-tuberculous osteitis with multiple circumscribed foci. *Acta radiol.*, 1927, viii, 86–105.

A report is given of 3 cases of a multiple form of circumscribed destruction in the bones of the hand and the foot which from the clinical and roentgenological viewpoint seem to comprise a separate disease group. The common feature in all the cases is the occurrence of well-defined areas of destruction in the wrist bones of both hands. In the first two cases there were destructive areas also in the phalangeal bones of the foot or in the heads of the metatarsals.

The circumscribed changes seen in the roentgenograms resemble to some extent those described by Jüngling and others as occurring in the multiple types of tuberculous cystic osteitis. The present cases were of an infectious nature but tuberculosis, syphilis, gout and fibrous osteitis were carefully excluded. These cases illustrate the fact that bony changes resembling those described under multiple cystic osteitis and which have been considered due to tuberculosis may also be due to other infections. It is suggested that this separate disease condition be called multiple circumscribed osteitis.

Horenstein, Victor. A case of calcification of the nucleus pulposus of the intervertebral disc. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 713–714.

A report is given of an unusual case occurring in a man aged forty. The calcification occurred during an ankylosing spondylitis and spondylarthritis. The edges of the individual thoracic and lumbar vertebrae were drawn out and pointed as in ankylosing spondylitis; several vertebrae were joined together with bridge-like osteophytes, especially in the lumbar region. In the frontal view of the thoracic spine, the eleventh thoracic vertebra was deformed to a wedge shape and the vertebral interspaces were hazy and partly dense, indicating an ankylosing arthritis. The interspace between the

eleventh and twelfth thoracic vertebrae showed an elongated, sharply outlined center of density toward the dorsal side which although not located exactly in the center could be explained only as a deposition of lime salts in the nucleus pulposus.

HULTÉN, OLLE. Calcifications in abdomen and pelvis after tuberculous peritonitis. *Acta radiol.*, 1927, viii, 126–129.

A report is given of a case occurring in a woman aged twenty-seven, referred as a suspected case of right-sided renal tuberculosis. The clinical examination was negative. The roentgen examination was astonishing. The abdomen and pelvis contained a number of shadows of lime density, the anatomical position of which was hard to establish. The diagnosis still remained doubtful and an exploratory laparotomy was performed. There was found increased fluid in the abdomen, numerous adhesions between omentum, intestines and anterior abdominal wall. Palpation revealed two calcified objects in the fat at the right lobe of the liver. One of these masses was removed for examination. The liver itself showed no hardening. The kidneys on palpation were normal. The mesentery contained in a number of places tuberculous lymphomas. The uterus was of normal size, retroflexed but freely movable. The left tube was reddened throughout and swollen, the right tube to a lesser degree. In the Douglas pouch several lime deposits were found subserously.

The operation revealed clearly that the shadows observed in this case were partly due to old tuberculous processes in the tubes and lymph glands and partly residues of a tuberculous peritonitis, as shown by an encapsulated abscess attached to the anterior abdominal wall. In addition there were peritoneal calcifications in the Douglas pouch and in the region of the liver.

Attention is directed to the fact that where numerous calcifications of various forms occur in the abdomen and pelvis, particularly when calcified lymphomas are also present, there is good basis for suspecting an old tuberculous process. Moreover, deposits of lime in the Douglas pouch may lead to the assumption of an intraperitoneal process. It is also evident that an encapsulated tuberculous process in the pelvis may suggest a concretion in the urinary bladder or in a diverticulum.

HULTÉN, OLLE. A case of "ivory vertebra" in lymphogranulomatosis. *Acta radiol.*, 1927, viii, 245–251.

The case described occurred in a farmer aged forty who was suffering from lymphogranulomatosis and presented marked skeletal changes which were confirmed at autopsy. Amongst the other symptoms the patient complained of pronounced backache which increased, and roentgen examination disclosed marked change in a portion of the spine. Some of the vertebrae were decalcified and destroyed and others were sclerosed. The sixth thoracic vertebra presented a normal density, the seventh showed a diffuse thinning out, the eighth showed a diffuse thinning out and partial compression, the ninth showed flaky density in the posterior portions, the tenth was diffusely intensified throughout, the eleventh showed the same picture except to a slighter degree, and the twelfth presented a normal roentgen density. The first lumbar showed occasional rarefactions, the second showed a pronounced diffuse condensation ("ivory vertebra"), the third showed flaky condensations in the anterior-inferior region, the fourth showed diffuse density but of slighter degree than the second. All the intervertebral discs seemed to be well outlined without signs of abscess formation.

IGLAUER, SAMUEL. The use of iodized oil in the diagnosis of pulmonary lesions. *Surg., Gynec. & Obst.*, 1927, xlv, 82–87.

The use of iodized oil as a contrast medium is of great value in chest roentgenography. The oil may be introduced perorally by several methods including the use of the laryngeal syringe, the special intubation tube, the bronchoscope, and the flexible catheter. It may also be introduced by puncture through the cricothyroid membrane, but this method is not recommended. The bronchoscopic method is preferable when specimens are to be taken, abscesses are to be evacuated or direct inspection is desired. Injection under the guidance of the roentgenoscope gives visual control and frequently establishes the diagnosis before films are taken. The most gratifying results have been obtained in the detection of bronchiectatic cavities. The multiform lesions of pulmonary tuberculosis are usually extraordinarily clearly shown.

Experience indicates that iodized oil may at times activate tuberculous lesions. Therefore in tuberculosis it should be used with caution and only when some special information is to be gained, for example, such information as is desirable before thoracic surgery is undertaken. Brominized oil appears to be less irritating than iodized oil and future experience may show that its use is to be preferred, especially

in tuberculous patients. Injected iodized oil is also of considerable value in the diagnosis of pulmonary abscesses, fistulae, tumors, and pleural effusions.

Jansson, G. A case of pneumatocephalus. *Acta radiol.*, 1926, vii, 1–5.

This occurred in a worker twenty-seven years old who suffered a fracture of the base of the skull. A roentgenographic examination disclosed air in the anterior horns of the lateral ventricles of the brain, the air having dilated these regions considerably. Operation and subsequent autopsy confirmed the roentgenological diagnosis and explained the reason for the penetration of the air into the cerebral ventricles. The fracture of the base of the skull had produced a split in the lamina cribrosa through which communication was established with the ethmoid cells. In addition, the very severe contusion of the brain had resulted in a softening of the brain substance in the same region giving rise to a fistulous passage between the anterior horn of the lateral ventricle and the crack in the lamina cribrosa.

Jarcho, Julius. Uterosalpingography; roentgenological visualization of the cavity of the uterus and fallopian tubes after the injection of iodized oils. *Surg. Gynec. & Obst.*, 1927, xlv, 129–142.

Roentgenological visualization of the uterus and fallopian tubes after the intra-uterine injection of iodized oil furnishes a valuable means of exact gynecological diagnosis in selected cases. In carrying out the transuterine injection of iodized oil the same principles of asepsis are practised as for the insufflation of gas for the Rubin test. The oil is injected slowly in a steady stream until 5 to 8 c.c. have passed. When a little more than 5 c.c. of the oil has been injected a roentgen picture is taken.

In cases of sterility the procedure yields information as to whether the tubes are patent or not and also localizes the site of an occlusion. It not only supplements the insufflation of gas but often supplants it. The technique is simple but strict aseptic precautions must be taken. The author is firmly opposed to the performance of the test on ambulatory patients. Properly performed, the test outlines the uterine cavity and the various portions of the fallopian tubes with great distinctness.

Proper interpretation of the roentgenological findings requires experience in this field. In some cases it is advisable to examine plates exposed at successive intervals or at different angles. In the author's experience the intra-uterine injection of iodized oil is entirely safe and harmless. No manifestations of iodism have yet been observed. Six cases are briefly cited and accompanied by 28 illustrations.

Johansson, Sven. A case of luxation of the os hamatum. *Acta radiol.*, 1926, vii, 9–13.

Brief reviews are given of 4 cases of luxation of the os hamatum reported in the literature; also of 4 cases of fractures. The author describes a case of luxation occurring in his own practice. The patient, a man aged fifty-five, fell a distance of about 9 meters. On examination in the hospital there was found a considerable swelling of the dorsal side of the right hand and pronounced sensitiveness over the proximal end of the second and third metacarpal bones. A roentgen examination of the hand showed the os hamatum with volar luxation and displaced distally with respect to the other carpal bones. Between the os hamatum and the os triquetrum a superficial, split-off, shell-like fragment of bone was noted which apparently came from the os hamatum. The articular space between the third metacarpal and the os capitatum was not distinguishable, apparently because of a subluxation between these two bones. An operation confirmed the roentgenological diagnosis, and also revealed a pair of additional fragments broken off from the third metacarpal bone. The os hamatum was extirpated, and the patient recovered with good restoration of mobility of the hand but with the strength somewhat diminished.

Kienböck, Robert. The roentgen diagnosis of tumorous conditions of the bones. *Acta radiol.*, 1926, vii, 51–64.

These tumors may occur as solitary foci, multiple or generalized. In most cases the solitary type is encountered. Any part of the skeleton may be the site of involvement; some of the conditions have a predilection for the trunk and more rarely that of the limbs. Others affect particularly the limbs. The head, as a whole, is comparatively seldom involved. In most diseases, especially those of the osteopoietic tissue of the bone marrow, the body of the bones is usually attacked and not the epiphysis; in the tubular bones the paraepiphyseal ends of the shafts are involved; less often the origin occurs in the mid-portions of the shafts, especially among adults. In cases of multiple involvement the attack is not confined to any particular region.

In diseases of the osteopoietic portions of the bone marrow, the condition usually begins in children and young people, much more seldom in adults and is particularly rare in old people. The opposite is the situation in the

case of the multiple Engel-Recklinghausen bone diseases (multiple tumor and cyst-forming osteitis fibrosa). The latter is also true for diseases of the blood vessels and hematopoietic portions of the bone marrow, particularly of metastases by which persons under twenty years of age are not affected. There is no sharp demarcation between the groups considered benign and those malignant. Some of the conditions seem to have a characteristic microscopic structure and others show variable features. Their classification and denomination is often very difficult.

The roentgen examination usually permits a correct diagnosis even in cases that are very difficult to define clinically. However, errors in the roentgenological diagnosis occur not infrequently. Thus, for instance, diffuse tumor-like changes are frequently interpreted as inflammatory or myelitic changes. Sometimes when the primary tumor is undiscovered the metastasis may be diagnosed as a sarcoma. There is hardly a detail of the roentgenological picture which is definitely pathognomonic of the particular disease present, or even as to which of the three main groups of bone conditions is being observed. Nevertheless, the collective impression and the coincidence of certain details permits a decision in most cases. The diagnosis is facilitated by the fact that different affections often exhibit somewhat typical pictures; to establish a correct diagnosis a precise skilled study of the individual case is necessary.

The author presents a classification of tumorous conditions of the bones under the following headings:

A. Primary tumorous conditions of the bones.
  a. Diseases of the osteopoietic tissue of the marrow (and the periosteum).
    1. Dysplasias with tumor formations (hyperplastic tumors).
      I. Exostotic dysplasia (exostoses).
      II. Chondromatous dysplasia (chondromas).
      III. Dupuytren-Nélaton and Engel-Recklinghausen bone disease.
    2. True blastomas.
      IV. Sarcomas.
  b. Diseases of the blood vessels of the bone marrow.
    V and VI. Benign and malignant tumors (angiomas, endotheliomas, angiosarcomas, and similar tumors).
  c. Diseases of the hematopoietic tissue of the marrow.
    VII and VIII. True bone marrow tumors (myelomas, lymphomas, "myelosarcomas," "lymphosarcomas").
B. Secondary metastatic tumorous conditions.
    IX. Daughter tumors, metastases.

Klason, T. Cystic kidney. *Acta radiol.*, 1926, vii, 65–68.

A description is given of 2 cases in women, one twenty-four years old and one forty-two. The pyelograms revealed the cystic degeneration of the kidney with the renal pelvis situated more in the center of the renal shadow than occurs normally. The pelvis was not enlarged in relation to the size of the kidney but, on the contrary, was rather narrowed from side to side by the intrusion of the cysts. The calyces were widened and irregularly arranged. The uppermost portion of the ureter was displaced medially. This abnormal position of the ureter was due to an enlargement of the kidney, and the altered position of the renal pelvis was caused by the cysts surrounding it on all sides. These findings were confirmed at operation in the first case and at autopsy in the second.

Knox, R. Unusual development of hyoid apparatus. *Acta radiol.*, 1926, vii, 69–72.

Roentgenograms of the hyoid region were taken of a patient suffering from a growth in the neck. There was a history of some bone disease in the same region more than ten years previously. In the upper part of the neck there were shadows very much resembling the outline of fingers. These unusual shadows on close inspection were found to bear no relation to phalanges and epiphyses of the hand. Subsequent examination in several positions showed clearly that the position was due to a developmental anomaly of rare occurrence.

The finger-like structure was seen passing up from below the outline of the lower jaw obliquely toward the cervical spine. Near the base of the skull and apparently articulating with the base of the skull, three distinct segments were seen with two gaps resembling joints. The bones in the upper part show a gap with irregular outline of the adjacent ends. It is possible that there may have been trauma at a previous time. In another roentgenogram the usual development of the hyoid bone was seen and above it on both sides the additional bony structure which was apparently an extension downward of the styloid process. In place of the stylo-hyoid ligament there was a well-developed bone articulating with the upper aspect of the hyoid. Another roent-

genogram showed the peculiar condition to be bilateral.

This case is rare because of the unusual development of the styloid process and the stylo-hyoid ligament on both sides. Both sides of the hyoid arch presented completely ossified units extending to the bone of the skull.

Krause, Paul. Post-typhoid bone diseases and their roentgenological diagnosis. *Acta radiol.*, 1926, vii, 81–90.

The following classification is presented:

1. Periostitis post-typhosa simplex.
2. Osteitis post-typhosa.
   a. Osteitis simplex without clinical periostitis
   b. Osteitis with secondary periostitis.
3. Osteomyelitis post-typhosa.
   a. Osteomylitis simplex with spontaneous regression.
   b. Osteomyelitis with sequestration usually associated with acute periostitis.
   c. Osteomyelitis with mixed infection producing suppuration.
   d. Osteomyelitis post-typhosa purulenta (streptococcus, staphylococcus, pneumococcus, *Micrococcus tetragena*).

The roentgen diagnosis in these diseases is especially valuable. The technique of roentgenography is somewhat different in the case of the anterior portions of the ribs, the sternum and the spine. The recognition of simple periostitis is easy. It is usually found as a band of $\frac{1}{4}$ to 1 cm. in width. Usually its extent is greater than is assumed clinically. Osteitis appears as a darkening and broadening of the dense portions. In long-standing cases there was sometimes seen a picture resembling syphilitic eburnation of the bone. The osteomyelitic foci appear as more or less distinct intensifications of the marrow cavity. Individual foci are more easily visible than diffuse disease of the bone marrow; in such cases bones of the other sides of the body must be examined for comparison. Examinations from different angles are advisable. Sequestra are easily recognized by the sharply circumscribed dark regions in the osteomyelitic foci. In older cases characteristic rarefactions of the bone above and below the disease process are recognizable. These are due to bone atrophies and remain recognizable roentgenologically for years. In mixed infections enormous tumor-like processes with periostitis may occur similar to certain forms of periostitis and osteomyelitis caused by staphylococcus infections.

The prognosis of post-typhoid bone diseases should not be regarded as unfavorable.

Larimore, Joseph W., and Graham, Evarts A. Diverticula and duplicature of the duodenum. *Surg., Gynec. & Obst.*, 1927, xlv, 257–265.

The roentgen-ray demonstration of duodenal diverticula depends upon the appearance in the vicinity of the duodenum of an abnormal side pocket which can be seen to fill and empty from the duodenum. Often this shows an air bubble. Roentgenograms demonstrate these conclusively, and stereoscopic films have been of assistance. Roentgenoscopy is in most cases necessary because a large orifice may allow prompt emptying, the horizontal portion of the stomach may obscure the picture, and redundant sacculations may be demonstrated as such by palpation. The majority of these diverticula are of the superior and descending portions and lie within the circle of the duodenum. A diverticulum to the right of the duodenum even in a high position is jejunal in origin. The roentgenological differentiation of congenital, acquired, and pseudo-diverticula cannot be conclusive. A gallstone may give a picture suggestive of diverticulum if observed only in association with the barium meal. Association of ulcer will give strong presumption for the acquired type and for a diverticulitis. Prolonged retention by the diverticulum favors the possibility of diverticulitis.

Another type of diverticulum encountered is the pseudo-diverticulum which is an actual side-pocket to the duodenal lumen. It is bypassed by the duodenal stream and shows prolonged retention. There is no defect in the wall of the duodenum and these pockets are extreme redundancies having fixed topography. Differentiation of this type can be fully made only at operation. They act as diverticula and are probably congenital in origin.

Three operative cases are reported, one of a large false diverticulum and 2 of pseudo-diverticula. These last 2 cases had pathological gall-bladders, the removal of which relieved all symptoms although the diverticular side-pockets of the duodenum persisted. Emphasis is given to the consideration of the gall-bladder in evaluating symptoms with which duodenal diverticula may be associated. Cholecystography has made possible an adequate gall-bladder diagnosis and is an essential procedure in these cases.

Larsén, T. The diagnosis of benign (gastric) tumors on the basis of the characters presented by the mucosa in the neoplastic zone. *Acta radiol.*, 1926, vii, 99–102.

A report is given of a case of benign tumor of the stomach (myoma) diagnosed roentgenologically on the basis of variations in the shape

of the mucous membrane in the vicinity of the tumor as seen on the roentgenogram. The case occurred in a man aged fifty-two. The roentgenoscopic examination showed normal peristalsis and motility of the stomach. At the terminal portion of the pylorus the peristalsis never reached the small or large curvature, and this terminal portion showed a diminution in filling of contrast material. About 3 cm. from the pylorus there was a variable retraction in depth. On the pyloric side of this retraction there could be seen a folding of the mucosa in the terminal portion of the channel. Operation confirmed the roentgenological diagnosis. There was a palpable tumor close to the pylorus which on resection and examination was found to be a myoma.

Lau, Knud. A case of phlebolites in an angioma. *Acta radiol.*, 1926, vii, 103–104.

A boy, aged twelve, was admitted with a tuberculous affection of the arm. The roentgen examination showed in the soft parts on the volar side of the forearm that there were about 20 roundish shadows of considerable density like osseous tissue. These shadows were all more or less distinctly stratified concentrically in layers of different density. The variation in size was from a pinhead to a pea. One fragment was as large as a bean. The bones of the forearm were natural in appearance, except for a certain haziness in the structure of that portion near the area containing the above shadows. An incision was made and the strongly twisted blood vessels were reached through an interstice in the muscles. This was undoubtedly a case of angioma, hence the incision was closed again; healing occurred by first intention. This case is probably rather rare owing to the youth of the patient.

Laurell, Hugo. Volvulus of the sigmoid flexure. *Acta radiol.*, 1926, vii, 105–141.

The author shows the importance of the roentgen examination with and without contrast meals for the diagnosis of all forms of volvulus of the sigmoid flexure. There is a form or stage of volvulus of the flexure which apparently has not been observed before or has received very little attention. This form is characterized by incomplete obstruction, absence of local meteorism, and, further, by diarrheal or bloody evacuation. The author shows that this form is not rare, but that it easily escapes attention owing to spontaneous uncoiling or a transformation into the typical form of volvulus.

It is believed that the principal cause of mesosigmoiditis lies in repeated twistings of the sigmoid accompanied by vascular strangulation. He believes that the reason for the greater occurrence of volvulus of the sigmoid flexure in males is due to the greater abdominal cross-section in this sex.

Laurell, Hugo. The position of free fluid, free gas and mobile inflated intestines in the abdomen. *Acta radiol.*, 1927, viii, 109–119.

It is not generally known that free fluid in excessive amount may occasion hepatoptosis in an individual standing upright when the fluid is caught between the diaphragm and the liver. This possibility should be kept in mind when a pleural puncture is considered in ascites, because puncture fluid obtained under such conditions may originate just as well from the pleural cavity as from the abdominal. Two illustrative cases are cited.

The sinking of the liver with the individual in the upright position is more or less opposed by the inflated intestinal coils lying beneath the liver.

Ordinarily conditions are such that a greatly inflated coil of intestine could not occur between the liver and the diaphragm. On the other hand, if for any reason, as in old age, there occurs contraction of the liver or when the lower aperture of the thorax together with the space in the upper portion of the abdomen becomes very much enlarged (as in pronounced emphysema) conditions become more favorable for such an interposition of an intestinal coil. In order for a hepatoptosis to occur in the upright position during ascites it is necessary that the fluid volume be very great, that the liver have a greater specific gravity than the free fluid in the abdomen and that no abnormal adhesions be present between liver and diaphragm. Furthermore, it is necessary that the lifting power of the underlying intestinal coils shall not be so great as to compensate or overcompensate for the weight of the liver. All such requirements are frequently present in ascites but the gas content of the intestines is often so great that the hepatoptosis does not occur.

Lewin, Philip. Multiple cartilaginous exostoses—diaphyseal aclasis. *Surg., Gynec. & Obst.*, 1927, xlv, 48–53.

Six cases of multiple cartilaginous exostoses are reviewed and attention is called to the similarity of this condition to chondrogenesis imperfecta or achondroplasia. The exostoses have been noted at as early an age as five months. Children have been born with this condition. Males predominate in the ratio of

about three to one. Heredity of the condition seems to be definitely established. The condition is rare in the colored race. Retarded puberty has been noted repeatedly and this fact, together with the frequent disappearance of the exostoses at puberty have been offered as proof of a glandular etiology.

This hereditary deforming chondroplasia, to which condition Keith has given the name "diaphyseal aclasis" or failure of the diaphysis to shape itself normally, is manifested by multiple painless exostoses occurring chiefly at the epiphyseal ends of the long bones, especially in the region of the knee joint. As stated, they may be found at birth, but they occur more commonly during young childhood. Occasionally they disappear spontaneously. They are benign and only infrequently require surgical treatment. The diagnosis is based upon the history, the exostoses and the roentgenograms. The differential diagnosis between osteitis fibrosa cystica, cysts of the long bones and other bone tumors should be readily made. The prognosis concerns chiefly the question of malignancy from chronic irritation. A malignant enchondroma might result.

Lindqvist, Silas. Some remarks on a case of postoperative peptic (gastro-jejunal) ulcer, penetrating into the anterior abdominal wall. *Acta radiol.*, 1926, vii, 165–171.

A case of duodenal ulcer was operated on in 1917, the operation being an anterior gastroenterostomy with the Braun entero-anastomosis and exclusion of the pylorus. Three months later a gastroduodenal ulcer seemed to have been established. In 1921 and since then, more and more symptoms developed quite typical of disease of the left urinary organs. There were symptoms of neuralgic pains caused by the penetration of the gastrojejunal ulcer into the anterior abdominal wall. A diagnosis of this ulcer was made in 1923. Clinically, there was an infiltration with a central cavity in the abdominal wall to the left of the umbilicus. There was well-marked tenderness over the gastroenterostomy region. The contrast-filled cavity in the anterior abdominal wall was immovable, there was also diminished mobility of the stomach. The contrast filled cavity itself was actually a giant niche perhaps enlarged by confluence of the gastroenterostomy opening and the Braun entero-anastomosis. The latter was not observable at the second operation.

Moller, P. Flemming. The radiographic picture in chalicosis, and its differential diagnosis from other affections of the lungs. *Acta radiol.*, 1927, viii, 193–208.

The changes occurring in chalicotic lungs in porcelain workers are quite characteristic, and when the condition has reached a certain stage of development the changes become visible roentgenographically and are of such a kind and character as to make it possible to establish the correct diagnosis, provided a flawless roentgenogram is available. As soon as the fibrotic degeneration caused by the dust particles has reached a certain degree of development, the changes characteristic of pneumoconiosis make their appearance in the roentgenographic picture. This stage is characterized by an increased density of the hilum shadows and marked reticular lung striations and also by a typical mottling throughout the lungs due to small fibrotic nodules, varying in size from a pinhead to a pea. These spots generally appear first on the right side about the hilum, later on they are seen more or less uniform, rather symmetrically arranged throughout both lungs. They are densest and most marked about the roots and less about the apices and bases. It is characteristic also that they are rather uniform in size and density, have a finely notched contour and that the intercrossing of these notches forms a delicate reticular pattern between them. This pattern is the result of the fine lymphatic vessels having become indurated at the same time that the peripheral connective tissue has shrunk.

The condition on progressing becomes one of diffuse fibrosis. Curiously enough, it is not unusual to find at this stage that the hilum shadows have become much narrower and much less accentuated than they were at an earlier period. Associated with the lung changes, pleural thickening will nearly always be found at this stage. Dense fibrous bands can be seen extending in various directions. The fibrosis in the lung itself may appear as large nodular densities, which may coalesce into irregular masses, more or less extensive, through which the separate nodules can still be detected. A comparison of roentgenograms of chalicotic lungs with pictures representing certain forms of tuberculosis and other pathological lung conditions, notably lymphogenous carcinomatosis and syphilis of the lungs, shows that the differential diagnosis may be rather difficult. The clinical findings and the history are emphasized as being of great importance in the correct interpretation of such roentgenograms.

Morison, J. M. Woodburn. A contribution to the study of diaphragmatic hernia of the eventration type. *Acta radiol.*, 1926, vii, 214–219.

Diaphragmatic hernia of the eventration

type may be congenital or acquired, temporary or permanent. All cases should be examined both in the upright and lying down positions. The principal points to be observed in the roentgenoscopic examination are the bow line in the chest forming a dome; the contents of the dome; lung tissue seen through the dome; movements of the bow line; level of the stomach contents; palpation of the abdomen; displacement of the heart; development of movements of the chest wall; deformity of the stomach. The author suggests that so-called eventrations of the diaphragm both congenital and acquired should be classified as diaphragmatic hernias, the particular variety being designated. It is shown that by recording the movements of the chest wall it is possible to differentiate congenital from acquired diaphragmatic hernias of the eventration type.

Nölke, Wilh. Uterosalpingography and its technique. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 698–703.

The employment of uterosalpingography is considered safe for outpatient treatment. This procedure is always preceded, by the author, by insufflation of oxygen through the tubes. Simplification of the technique and modification of the instruments are necessary for satisfactory outpatient treatment. The insufflation of oxygen is performed by the Samuel modification of the Rubin technique. The flow of gas is carefully controlled by means of a valve and manometer. A device for automatically holding the instruments in the ball forceps is essential for satisfactory manipulation. The contrast material is a sterile solution of 35 per cent sodium bromide, 20 per cent iodipin, kontrastol or umbrenal. The contrast fluid is injected by the compression method either by means of a rubber bulb with a pressure up to 200 mm. Hg or without pressure from a simple syringe. Any of the above opaque fluids may be used, and thus far none of them has been found to cause injury. The roentgenograms are taken with the Bucky diaphragm on a plate 24 × 30, 60 ma., 55 kv. effective, exposure 6 to 8 seconds.

The indications for uterosalpingography are primarily in occlusion of the tubes, displacement of the uterus, tumors, and extrauterine pregnancy. The procedure is contraindicated in the presence of any inflammatory process and pregnancy. The above method was employed in more than 60 ambulant cases and no injuries were observed. The patient after the uterosalpingography was sent home and required to remain under observation of a physician for two days. Four cases are briefly described and illustrated to show occlusion of the tubes, peristalsis of the tubes, displacement of the uterus, result of the transplantation of the tubes, and permeability of the tubes after forcible clearing of the occlusion by the pressure method.

Odelberg, Axel. Roentgen investigations of contrast-filled gall-bladders. *Acta radiol.*, 1926, vii, 220–228.

The intravenous injection of tetrabromphenolphthalein was employed by the author for cholecystography in 17 cases. A pronounced reaction was obtained in one case and a weak reaction in another. Eleven of the cases were operated on and the operative and microscopic findings confirmed the conclusions made from the cholecystographic examinations.

Odelberg-Johnson, G. Three cases of bronchial gland tuberculosis with compression symptoms. *Acta radiol.*, 1926, vii, 229–236.

In one case compression of the principal bronchus occurred between the caseous tracheobronchial glands and glands at the bifurcation, in a child one year old. The child died of an acute pneumonic tuberculosis and autopsy confirmed the roentgenographic findings. In the second case there was mild compression of a main bronchus caused by enlarged tracheobronchial glands, and in the third case there was displacement of the bronchial tree and of the lower portion of the esophagus to the left by enlarged tracheobronchial and bronchopulmonary glands in the right hilus. In the latter 2 cases lipiodol was employed to trace out the bronchial tree. The diagnosis of bronchial gland tuberculosis was quite clear in the above described cases. In other cases where for instance the density of the compressing glands is low, the demonstration of stenosis and displacements of the bronchial tree or esophagus would be of considerable help in the diagnosis.

Odqvist, Henning. The roentgen diagnosis of abdominal tumors. *Acta radiol.*, 1926, vii, 253–258.

Dermoid cysts containing much fat and cholesterol and therefore possessing less power of absorption for roentgen rays produce negative shadows. Consequently, even in the absence of teeth such dermoid cysts may be diagnosed roentgenographically by their production of a negative shadow. Retroperitoneal lipomas may also produce such negative shadows but of lower intensity and not so distinctly outlined. The author presents reports of 2 cases of dermoid cyst which presented

these negative shadows in the roentgenogram and were confirmed at operation. A third case of retroperitoneal lipoma was diagnosed roentgenographically as a possible dermoid cyst on the basis of the negative shadow produced. One of the major difficulties in securing a good roentgenogram is the interference of intestinal gas.

PALUGYAY, JOSEF. A traction-pulsion diverticulum of the esophagus located epiphrenally, and spasm of the Killian mouth of the esophagus. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 769–773.

A report is given of a case occurring in a woman forty-two years old, the case being unique because of the concurrence of a spasm of the esophagus with a deep traction-pulsion diverticulum. The roentgenogram on three different occasions showed the same general picture. Immediately above the diaphragm a little to the left and front of the contrasted esophagus, there was seen an oval dense shadow about the size of a pigeon egg and having a smooth outline. With the emptying of the esophagus there occurred a rapid decrease in size of the shadow so that at the end of twenty-four hours there remained only a small spot the size of a bean. Between this structure and the contrasted esophagus there was visible at all angles a broad connecting band. The shadow of the diverticulum showed a distinct change in form with deep breathing. The early examinations of the esophagus and cardiac end of the stomach showed nothing unusual morphologically or functionally. In later examinations there was also observed on two occasions evidences of intermittent spasm of the mouth of the esophagus and intermittent hypotonia of the esophagus. Contrast meals of different consistencies were held up in the cervical portion of the esophagus and backed up into the mouth so that the throat appeared somewhat dilated. At the level of the mouth of the esophagus there was evident a distinct contraction through which the contrast material, even when fluid, passed extremely slowly. In the region of the contraction the contour of the filling material was smooth and above it there was distinct concentric banding. Below the constriction the contrast paste trickled slowly out of the esophagus.

A consideration of the facts in this case suggests that the spasm was a secondary effect caused by the diverticulum. This suggests that in cases of spasm of the esophagus the possibility of a traction diverticulum being the etiologic agent should be taken into consideration.

PANNER, H. J. A case of colic invagination with characteristic roentgen picture. *Acta radiol.*, 1926, vii, 269–279.

In cases of chronic or subchronic colonic invagination, the condition of the patient will often permit an examination being made both by the opaque meal and the opaque enema. In a few cases the subsequent roentgen examination may yield a characteristic result, but it is not possible to say beforehand which of the methods will most likely be successful in yielding a diagnosis. It is therefore best whenever possible to employ both. Nevertheless in the majority of cases the diagnosis seems to be negative. In a good many instances it will probably be possible to make out an enterostenosis, but it will not be possible to determine either its nature or its exact situation.

In acute cases of colonic invagination the condition of the patient will prevent the administration of any opaque mixture either by mouth or per rectum. Roentgenoscopy without use of opaque medium remains the only recourse and in some cases it may perhaps be possible to elicit evidence of an enterostenosis. However, the author does not believe that it will be possible by this means to obtain any picture at all characteristic as to the nature or the site of the obstruction.

A report is given of a case occurring in a man aged sixty, suffering from a chronic colonic invagination. The opaque meal showed normal condition of the stomach and duodenum. An opaque enema showed a clear colon, sigmoid, descending colon and splenic flexure, but at about the middle of the transverse colon there was an obstruction. At that point the viscus was very much distended. The flow of enema first seemed to become suddenly arrested but little by little it was seen to continue in two narrow branches as if passing on either side of some object filling the lumen of the intestine and distending it. Further on the two branches re-united and formed a rather compact shadow corresponding to the transverse colon which was very much distended. When the enema was evacuated the intestine from the point of obstruction to the anus was cleared of nearly all its contents while orally from the obstruction the dense shadow remained. The diagnosis was that of a broad-based tumorous growth, not sufficient attention being attached to the abrupt checking of the flow at the slight distance orally from the supposed tumor. A laparotomy was performed and it was found that about 10 cm. of the colon had become invaginated in itself, and at the distal end of the invaginated portion there was a large,

partly ulcerating, gelatinous carcinoma with raised edges.

PENFIELD, WILDER. Chronic meningeal (post-traumatic) headache and its specific treatment by lumbar air insufflation; encephalography. *Surg., Gynec. & Obst.*, 1927, xlv, 747–759.

Seven cases of post-traumatic headache and dizziness are described. In all of them the headaches were completely relieved by lumbar insufflation of air. All were enabled to resume their normal activity by day and to sleep soundly by night. The ages of the patients varied from four to sixty-five years. In each case the complaints dated from the time of a head injury occurring from four weeks to eight years earlier. The amount of air injected varied from 42 to 95 c.c. The immediate reactionary headache lasted from three or four up to nine days after insufflation. The pneumograms showed a cyst of the pia-arachnoid in 3 cases at least. There was frank escape of the air into the subdural space in 3 cases. With the absorption of the air the headache likewise disappears.

The fact that a certain group of headache cases seems to be curable by a specific form of treatment singles these headaches out from all others and makes it likely that they are caused by a common mechanism. This mechanism obviously has to do with an abnormality in the cerebral meninges. The abnormality, whatever it is, is obviously a mechanical one.

PUGH, WINFIELD S. Diverticulum of the urinary bladder. *Surg., Gynec. & Obst.*, 1927, xlv, 629–636.

The author's studies of bladder diverticula lead to the conviction that there are definite cases of congenital diverticula. Apparently a congenitally weak spot exists in the bladder in all cases. Pulsion and pelvic adhesions provide the active means of producing the actual sacculation. Medicinal treatment seems to be of little value in diverticulum of the urinary bladder. Some cases can be cured by excision. In many, cure cannot be effected but great relief may be secured by palliative procedures. Seven illustrative cases are cited.

The diagnosis of bladder diverticula, as a rule, can be made by means of a careful cystoscopic examination. There are, however, some cases which will escape the eye of the most painstaking observer. The cystoscope, while it gives us the location of the sac, does not distinguish retention and non-retention types. In the presence of masses it may also be unreliable; the same may be said of prostatic hypertrophy. Since 12 per cent sodium iodide solution as used in cystography is quite irritating, it has been replaced of late with a 5 per cent solution of neosilvol which is much less irritating to the vesical mucosa. Simple cystography does not give an exact idea of the position, size and contour of the diverticular sac. In many cases upon opening the bladder area there is found a much greater sac than anticipated. Lateral cystograms give a better impression of the diverticula on any particular side. The contrast between an anteroposterior picture and a lateral one is often quite striking.

REISER, EGON. The roentgen examination of the bladder. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 756–769.

Just like any other body cavity, the bladder should be examined with the minimum possible amount of contrast material. Roentgenoscopy is practically indispensable for demonstrating small or hidden changes. In addition to 20 to 30 c.c. of 20 per cent iodipin it is advantageous to inject an equal quantity of air. This combined filling permits the detection of hidden changes by the ordinary sagittal or oblique view. This avoids the difficult lateral roentgenograms and roentgenoscopy which make very high demands upon the tubes. This practical advantage is obtained exclusively by employing the combined filling with air and contrast medium. Even in corpulent individuals it yields clear and detailed views in the roentgenoscope. It does not seem to irritate the bladder mucosa and is retained in the quantities given indefinitely by all patients. Before introduction of the iodipin, the urine, which does not mix with it, should be as completely removed from the bladder as possible. The examination may be made with the patient standing or recumbent. The smaller the degree of filling of the bladder, the nearer to the edge will abnormal structures move and it is consequently less difficult to reveal them. Even small tumors of the bladder mucosa may be distinguished within the shadow surface or at its boundary because they are more easily able to project from the lower layer of fluid into the supernatant air space. This effect may be increased in distinctness by compression. The above observations are confirmed in a number of cases in which small or obscure structures were demonstrated and subsequently confirmed by cystoscopy or operation. The author emphasizes that roentgenoscopy of the urinary bladder is possible in all cases, including corpulent individuals.

RENANDER, AXEL. Roentgen-diagnosed anomaly of oesophagus and arcus aortae. Dysphagia lusoria. *Acta radiol.*, 1926, vii, 298–308.

An account is given of a case of dysphagia lusoria in which the diagnosis was established after roentgenoscopic and roentgenographic examination in several different projections. The cause of the dysphagia in this case was shown to be due to a displacement of the arch of the aorta causing the esophagus to run above and partly in front and to the left of the aorta. This peculiar course of the esophagus is shown to be due to the persistence of the left subclavian artery from a portion of the dorsal aorta lying between the juncture of the two branches of the dorsal aorta and the sixth left segmental artery from which it developed. As a result, this left subclavian artery assumes a position behind the esophagus which in the course of its development is forced forward by this artery at the level where it leaves the concavity of the arch of the aorta.

RENCK, G. Aneurysm of the renal artery, especially from the roentgenological viewpoint. *Acta radiol.*, 1926, vii, 309–321.

The author summarizes 40 cases of renal aneurysm, 22 of which are considered genuine spontaneous aneurysms. Detailed report is given of 3 such cases which were observed roentgenologically at the Maria Hospital, Stockholm. The first of these cases was previously described by Key-Åkerlund, and from the data thus established it was possible to make the first definite roentgen diagnosis of renal aneurysm in the next 2 cases. The roentgen pictures in the 3 cases were uniformly characteristic and presented the following signs: The calcified renal aneurysm appears as a round or oval shadow from about the size of a pea up to that of a walnut, with a dense, distinct outline and transparent center. Sometimes one can notice a marked defect in the outline corresponding to the opening in the aneurysmal wall. The aneurysm is localized in the renal hilus. Pyelography shows that it is situated outside, but at the same time close to the pelvis, causing more or less pronounced impressions in the shadow of the kidney pelvis.

This roentgen picture which describes the calcified renal aneurysm should apply also to similar structures in other arteries. The author has seen, for instance, such aneurysmal structures in the arteria basilaris and the arteria cerebri media which resembled the renal aneurysm in essential features.

RIEDER, H. Roentgenological and especially roentgenocinematographic observations in organic stenosis of the pars superior duodeni. *Acta radiol.*, 1926, vii, 340–357.

In contrast to the clinical symptoms of stenosis of the upper part of the duodenum, surer signs can be obtained roentgenologically, namely, retention and dilatation of the bulbus duodeni, together with certain peculiar movements of the organ. These consist of a series of rapid, irregular, undulatory motions of the wall of the bulbus in an orthograde direction and never transmitted retrograde toward the stomach. A rhythmic peristalsis with formation of circular waves such as occur in the stomach does not take place; the peristaltic gastric movement extends only up to the pylorus and does not continue to the bulbus. The individual phases of the bulbus waves vary extraordinarily in position, shape and size. This feature can be easily illustrated by the superposition of individual cinematograph pictures.

In addition to the above-named movements, it is sometimes possible to perceive girdle-shaped contractions in the mid-part of the bulbus, i.e., at the boundary of the pyloric and distal regions of the bulbus. These contractions, however, soon disappear, followed by a rapid movement of the contents of the bulbus and evacuation distally. The motor processes discussed appeared only after somewhat heavy filling of the bulbus and they subsided during the process of duodenal digestion, that is, with appreciable emptying of the bulbus.

RUHMANN, WALTER. The origin of gastroptosis (neuromuscular aspects). *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 743–749.

It has long been observed that the position of the filled stomach in one and the same individual may vary quite considerably not only from day to day but during the course of a single roentgenoscopy. This has occurred although extragastric pressure factors seemed to be definitely excluded. Further examinations showed that a cooling of the abdominal skin in 11 out of 32 cases examined caused a medium but quite distinct sinking of the stomach, although the patient had been cautioned to hold the breath and other factors seemed to be excluded. These observations lead to the hypothesis that the innervating mechanism of the smooth muscle might have a considerable significance on the so-called "state" of the stomach.

A number of factors will have to be evaluated, but there seems to be a definite gastrogenic factor in many cases of gastroptosis which is largely independent of the surroundings of the organ and of external pressure conditions. The filled stomach is not quite so

dependent on adjacent organs as is usually assumed. The lifting power which contributes to the regulation of the so-called position of the pendant stomach is controllable neurologically. The nerves whose action predominates when the above effect is absent and thus contribute to sinking of the stomach are as yet vaguely known. The assumption that sympathetic nerve activity occasionally predominates and is responsible requires further explanation. The fact, however, remains that there is apparently a function of the gastric musculature to maintain an elevation of the ingesta. This activity of certain muscular portions is called the lifting power of the stomach as opposed to the mere resistance to tension (peristole). This lifting power is named by the author anastole, and he explains gastroptosis as being an anastolic insufficiency.

Schaumann, Jörgen. Notes on the histology of the medullary and osseous lesions in benign lymphogranuloma and especially on their relationship to the radiographic picture. *Acta radiol.*, 1926, vii, 358–364.

The disease described by the author in 1914 under the name benign lymphogranuloma and of which lupus pernio and Boeck's sarcoids are skin phenomena, manifests itself like other diseases of the lymphatic system also in the bone marrow where it takes the form of tuberculoid granulations similar to those found in the lymphatic glands, the tonsils and the skin. The medullary lesions may be variously related to the osseous surroundings. The process develops so as to utilize the marrow space as far as possible without invading the osseous surroundings, and thus remains a disease of the marrow alone. As a consequence, cases may show a completely granulomatous transformation of the marrow with roentgenographically and microscopically normal bones.

In other cases, the medullary lesions exert a rarefying action on the bone tissue, evidenced by enlargement of the lacunae and of the Haversian canals. When the rarefaction progresses still further, there may appear circumscribed zones of bone disappearance (most frequently in the ends of the smaller tubular bones) and surrounded by healthy bone lamellae. The medullary lesions may extend to the extra-osseous tissue to produce swellings of the fingers and toes resembling spina ventosa.

Silfverskiöld, Nils. A case of post-traumatic necrosis in the calcaneus and cuboideum with changes suggesting "local malacia." *Acta radiol.*, 1926, vii, 473–475.

The case occurred in a girl aged five, who received a severe and sharply localized injury to the right metatarsus. This resulted, five months later, in visible involvement of the calcaneus and cuboid which in several respects suggested disease similar to Calvé-Legg-Perthes' and Waldenström's disease. The distal portion of the calcaneus and the proximal portion of the cuboid showed large bone defects so that both bones were separated by an irregular lime-free space. The defect in the bony tissue involved approximately the proximal third of the cuboid and extended centrally into the calcaneus up to the proximal half of this bone. The bone walls of the defect were very irregular and close to it was a pronounced bone atrophy which gradually merged into bone of normal density. There were no sequestra, no periosteal stratifications, nor was there any other sign of atrophy in the rest of the foot.

Söderlund, Gustaf. On the roentgen diagnosis of renal tuberculosis. *Acta radiol.*, 1926, vii, 503–522.

An analysis was made of 162 cases of kidney tuberculosis which were examined roentgenographically. It was found that the roentgen examination gave a positive diagnosis in 52 of the cases, in 29 of which the finding was of decisive value in establishing diagnosis or the mode of treatment. These 29 cases fell into six groups as follows: (1) Six cases; both ureters were catheterized but no tubercle bacilli could be demonstrated in the urine either of the bladder or of the ureter. There were no bladder symptoms distinctive of tuberculosis. (2) Four cases. Only the ureter of the healthy kidney was catheterized. No tubercle bacilli were found in the urine of either the bladder or the ureter. The urinary bladder showed no distinctive signs of tuberculosis. (3) Four cases. Catheterization showed positive pus and tubercle bacilli. A roentgen examination also showed tuberculosis of the other kidney. (4) Six cases. Cystoscopy was impossible owing to stricture or narrow urethra. (5) Four cases. Ureteral catheterization was not possible owing to bladder changes. (6) Five cases. Closed kidney tuberculosis. Tuberculous process at the time of examination not involving the bladder.

In no less than 42 of the cases the roentgenograms of the kidney and ureters showed lime shadows caused by the tuberculous process, and in 31 of these cases the shadows were so characteristic for tuberculosis that kidney tuberculosis could be definitely diagnosed from the roentgenogram alone. In 2 cases the nature of the shadows was uncertain and in 9 they showed a greater resemblance to

lithiasis. Of the remaining 10 cases with positive roentgen findings, one showed contractions of the kidney shadow at the hilus, corresponding to the lower pole of the kidney, another showed cavitation in the pyelogram, in 2 others cavitation was shown by the double contours in the kidney shadow, in one case thickening of the ureter was evident in the shadow, in 2 cases there occurred a bulging of the kidney pelvis and in 3 cases the roentgenogram showed enlargement of the kidney shadow on the diseased side.

Stenvers, H. W. The importance of roentgenology in neurology. *Acta radiol.*, 1926, vii, 559–567.

Roentgenography is an indispensable diagnostic tool for the neurologist. However, the interpretation of the roentgenogram requires very careful and critical study. It should always be remembered that the roentgenogram is merely one part of the entire clinical story. The roentgenogram is not only valuable in cases of unusual nature but it is of the greatest importance in the differential diagnosis of apparently simple cases. The roentgenography of the ventricles reveals a great deal but should be undertaken only when indicated by the neurologist. It is the author's belief that roentgenological treatment should be tried in every case of inoperable tumor of the brain or spinal cord.

Stephens, Virgil R. Ileocaecal intussusception in infants, with special reference to fluoroscopic findings. *Surg., Gynec. & Obst.*, 1927, xlv, 698–700.

The author has operated on 6 cases of ileocecal intussusception in infants under one year of age, with one hospital death which occurred on the seventh day following operation. Autopsy of this case was not permitted. Roentgenoscopic examination with an opaque enema was made in 3 cases with very gratifying results. The characteristics of the roentgenoscopic picture as observed were: (1) an enlargement of the caliber of the barium column as it approached the intussuscepting mass; (2) a definite tendency toward the formation in the opaque medium of a concave presenting surface with pointed edges. This was true whether the force was sufficient to move the intussuscepting mass backward or not; (3) a thin, somewhat cone-shaped sprinkling of barium in front of the concavity which probably corresponds to the so-called "mantle" of Regnier and represents the advancing rim of the barium cylinder.

It would appear that the roentgenoscopic examination should be of diagnostic value in cases with doubtful history or physical findings. It may be of service in partly or wholly reducing the intussusception and at the same time proving the result.

Troell, Abraham. Benign tumors of the stomach, especially from the diagnostic viewpoint. *Acta radiol.*, 1926, vii, 568–586.

A number of cases confirm the view that the roentgenological finding of a sharply defined, rounded, mobile, filling defect in the stomach shadow after an ordinary opaque meal is practically pathognomonic for benign neoplasms (especially myoma, angioma, etc.). Varying emptying time of the stomach at different examinations is of diagnostic importance, especially insofar as such variation may be due to the existence of a polypoid massive tumor seated near the pylorus and therefore tending to force its way into it. The author's cases of submucous myoma and of papilloma in the stomach confirm the great diagnostic value of the roentgen examination in this region. A feature of decisive importance is the roentgenological demonstration in the stomach shadow of a large, even, rounded filling defect with good mobility and with a smooth contour quite near the defect. In cases (papilloma) where the defect observed after the usual opaque meal exhibits a varying appearance on different occasions, an examination should be made after inflating the stomach with air. If this is done there is prospect that the sharply defined shadow will be easily visible. The emptying of the stomach may vary to an extent which does not occur in cancer. The volume of the stomach does not as a rule show any decrease. Gastric polyposis can be diagnosed through the roentgenological demonstration of a constant undulancy over a part of the greater curvature, isolated polyps being shown by persistent defects within this contour.

The valuable diagnostic factors mentioned indicate the desirability of careful roentgenological examination in such cases. This holds true especially as to patients with attacks of melena occurring for a relatively long time but without any other symptoms of ulcer, and also patients with marked anemia of a secondary type which arises gradually but without any demonstrable etiology. The treatment suggested is a radical resection of the stomach rather than mere extirpation of the tumor.

Wierig, Alfons. On the lung markings in the roentgenogram. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 704–713.

A few cases are cited to illustrate the fact that diseases of the vascular and lymphatic system may markedly affect the roentgen picture of the lungs and lead to errors in the roentgen diagnosis which are cleared up only by postmortem examination. In one case there was a typical picture of miliary tuberculosis of the lungs which proved to be a purely vascular stasis. The formation of the structures resembling circumscribed foci was found to be due mainly to a regular distribution of heart failure cell depots.

Congested lungs due to cardiac decompensation are especially extensive with mitral lesions and result in a blood accumulation in the capillaries and smaller venous channels. As a result there is a general more or less pronounced clouding of the lung field. At the same time there also occurs an intensification and broadening of the larger blood vessel shadows due to the general venous hyperemia. This lung marking in the advanced case may easily give the impression of a more or less regularly distributed focal infection of the lung tissue, a picture which may even deceive the experienced observer. It is therefore essential to give first attention to the heart in all cases exhibiting pathologic lung markings in the roentgenogram. Since stasis in the smaller circuit may occur not only with typical mitral lesions but also in myocarditis and other heart conditions especially of the left ventricle, the analysis of the heart finding and its interpretation with respect to the pulmonary diagnosis may not always be very easy.

Wierig, Alfons. The technique of bronchography. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 787–789.

Despite improvements made up to the present, the method of bronchography should be reserved for the clinic and is not practicable for ambulant cases. The method employed by the author is essentially that described by Lorey, and has been employed successfully in 200 cases. The advantage of the method lies in the fact that it is possible to fill with contrast medium a definite section of the bronchial system without requiring that other branches be filled. The throat is anesthetized thoroughly down to the bifurcation. Use of the bronchoscope is avoided because of the great irritation to the patient. The Lorey sound with rubber catheter is carefully passed between the relaxed vocal cords down the trachea to the bifurcation then into the right or left branch of the bronchus as required. If it is required to fill the bronchus of the upper lobe the patient is turned on the desired side, the pelvis raised sharply and the sound inserted only a short distance in the main bronchus to the approximate inlet of the branch to the upper lobe. With the bronchoscope in operation the warmed iodized oil (40 per cent iodipin) is introduced under medium pressure, the patient being shifted in position or the sound moved backward or forward until the desired filling is obtained.

With bronchi of normal width about 15 to 20 c.c. of oil is required. As much as 75 c.c. has been injected in certain cases without discomfort or serious consequences to the patient. A greater amount of contrast oil than is absolutely required should never be injected. The procedure seems to be applicable even in patients who are very sick.

Wilhelm, R. Deficient development of the os naviculare in congenital club foot. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 735–742.

As a result of the appearance of several unusually persistent cases with repeated relapses, a roentgenological study was made of all cases of congenital club foot appearing for treatment during the past two years. In these cases the roentgen picture disclosed a more or less considerable disturbance in development of the os naviculare ranging all the way from the milder grades to entire absence of the bone. The development of the os naviculare and of other tarsal bones for each year between the ages of one and twelve was studied with the aid of 70 roentgenograms of the normal feet of children. Certain interesting points were noted in regard to the conditions of ossification of the scaphoid bone and the retardation of ossification in rickets, poliomyelitis and congenital luxation of the hip joint.

In roentgenograms of club feet from the first to the fifth years a pronounced retardation of the normal ossification was found. In 44 roentgenograms only 8 showed a well-developed os naviculare. In 56 roentgenograms of individuals over five years old, 12 showed deficient development as regards shape and size of the scaphoid bone; in 11 the os naviculare was altogether absent. The author suggests the possible connection between the disturbance of development in the scaphoid bone in congenital club foot and Köhler's disease of the os naviculare. From the practical point of view the above roentgenological studies justify an operative treatment in obstinate cases of club foot due to absence or great deficiency of the scaphoid bone. Only a compensating shortening of the external margin of the foot can produce

permanent correction of adduction and supination in this type of malformation.

## ROENTGEN AND RADIUM THERAPY

Andrén, Gunnar. The radium treatment of haemangiomata, lymphangiomata and naevi pigmentosi. *Acta radiol.*, 1927, viii, 1–45.

A summary of the results obtained at the Radiumhemmet, Stockholm, is given. Between 1909 and 1924 there were treated 76 capillary, 138 superficial cavernous and 59 deep cavernous hemangiomas, all of these cases having been subsequently reëxamined. The radiological treatment in most cases was with radium and in a few cases with roentgen rays. The expectant method of treatment introduced by Forssell is recommended. The main principle of this is the use of relatively weak doses at considerable intervals. Each dose should be, as a rule, about 80 per cent of the erythema dose. The hemangiomas are carefully watched between treatments and the dose is not repeated until improvement has taken place. Often only one such treatment is required to initiate healing resembling the spontaneous type. A cosmetically more favorable result is obtained by this method of treatment than by any other in use. The treatment with roentgen rays was generally with $\frac{1}{4}$ S.U.D. through 4 mm. Al filter.

The radiological treatment of capillary hemangiomas yielded cosmetic restoration only in children in the first year of life and only where the lesion did not exceed 10 × 35 mm. The more extensive lesions have not yielded very satisfactory cosmetic results. There were 15 cases of stellate hemangioma and these were all restored cosmetically after thermo-puncture of their central capillaries.

One hundred and eighteen cases of superficial cavernous hemangiomas were treated by the Forssell expectant method and about 70 per cent of these were cosmetically restored and 30 per cent improved. In no case did atrophy develop. In 14 per cent only one application was necessary. In 16 cases radium was given in doses which produced an inflammatory reaction of the second degree. Of these 30 per cent became cosmetically restored and 70 per cent developed atrophic changes. Hemangiomas in the scalp have been successfully treated by Forssell's method without causing permanent epilation. Cavernous hemangioma frequently takes on rapid growth during the first year of life and should therefore be treated during this period. The size of the hemangioma does not seem to affect the therapeutic result.

Forty-five cases of deep cavernous hemangioma were treated by the Forssell method, 28 being cosmetically restored and 17 improved. None developed atrophic changes. Elimination of primary beta radiation by means of 0.5 to 1.0 mm. extra lead filter has been of great value in attaining a cosmetically satisfactory result. The treatment by roentgen rays was employed in a small number of cases. Improvement followed but no cosmetic restoration was noted.

*Lymphangiomas.* There were 11 cases of subcutaneous and cavernous types. The treatment given with 2 to 3 mm. extra lead filter and producing inflammatory reaction of the second degree produced cosmetic restoration in only 2 cases. Where a lower degree of reaction was obtained, no effect whatever could be observed. It is probable that more intensive radiations sufficient to produce a depth effect may yield satisfactory results without risk of secondary atrophy of the skin. The age of the patient does not seem to be of the same importance in lymphangiomas as in hemangiomas.

*Epidermal Nevi.* Radium treatment was given to 11 cases of pigmented nevi and 35 cases of pigmented and hairy nevi. Subsequent reëxamination showed that successful removal was accompanied by inflammatory reaction of the second or third degree. With such treatment there occurs the risk of complication by secondary atrophies. Electrocoagulation was substituted for treatment by radium in these cases, and in all cases cosmetic restoration was obtained irrespective of the size of the nevus. Since there is a risk of malignant degeneration of these nevi, the author believes that they should be treated as early as possible.

Bordier, H. Roentgen ulcers—efficacy of diathermy. *Acta radiol.*, 1927, viii, 189–192.

A report is given of a case in a woman who had undergone roentgen treatment for a uterine fibroid. The woman developed several months later roentgen ulcerations over the lower part of the abdomen accompanied by severe local pain and impairment of the general condition. The treatment of the roentgen ulcer consisted of applications of diathermy over a period of six weeks. The patient received daily applications with 10 × 12 cm. electrodes over each iliac fossa, 1000 ma., for 20 min. To this was added emanations with a vacuum electrode and carbolic oil dressings. Complete healing took place in four months.

Handley, W. Sampson. Parasternal invasion of the thorax in breast cancer and its suppression by the use of radium tubes as an

operative precaution. *Surg., Gynec. & Obst.*, 1927, xlv, 721–728.

The key to further advances in the operative treatment of malignant disease is not to be found in statistical studies in which large numbers of cases are superficially studied, often at second hand, in the light of existing knowledge. It is in the ward and laboratory rather than in the bureau of health statistics that the information we require is to be sought. The present paper aims at showing that in many cases of breast cancer early invasion of the lymphatic glands lying along the internal mammary arteries takes place at a date prior to operation.

The growth of these microscopic colonies sometimes after many years of quiescence falsifies the hope of cure. Nodules of growth at the inner end of the upper intercostal spaces, or a lump in the sternum ultimately make manifest the latent process. An intelligent appreciation of this danger and the use of proper means to deal with it in its earliest stage can improve the operative results. The improvement in the results obtained by the author is attributed to the fact that radium tubes have been inserted as a prophylactic in nearly every primary breast operation. The standard procedure is to insert four 25 mg. tubes screened by 1 mm. platinum in the following positions, one tube at each place for twenty-four hours: (1) Above the first rib internal to the subclavian vein in the position of the terminal portion of the main lymphatic duct whether right or left. This tube lies close to the gland at the lower and inner angle of the posterior triangle, the gland in which supraclavicular recurrence first shows itself. (2) At the inner end of the first intercostal space, buried in the intercostal muscles. (3) At the inner end of the second intercostal space. (4) At the inner end of the third space. Tubes 2, 3, and 4 it will be seen follow the course of the lymphatic trunk which accompanies the internal mammary artery and lie close to the glands which are contiguous to this artery.

The placing of these tubes is based upon a close study of the recurrences which took place in the previous series of cases in which the same operation and the same roentgen-ray course were employed but no radium was used. Local and axillary recurrences are almost absent from the series. These forms of recurrence have been almost abolished by the improved technique of the modern operation which takes account of the centrifugal spread of the disease by permeation of the lymphatic plexus of the deep fascia.

JÜNGLING, OTTO. Results of the roentgen treatment of bone and joint tuberculosis in the region of the foot. *Acta radiol.*, 1926, vii, 14–27.

In the Tübingen Surgical Clinic 64 cases of foot tuberculosis were treated with roentgen rays during 1907 to 1924. There were 36 cases of tarsal joint involvement, 21 of the mid-tarsal bones and 7 of the toe joints; 24 cases were of the fungous type and 40 were fistulous; 35 of the cases were in children. Before 1919 strong doses were used on 13 cases with the result that 7 became non-active, 3 seemed unaffected by the treatment and 3 showed aggravation of the condition. The remaining 51 cases were treated since 1919, with milder doses. In this group 35 were rendered non-active, 13 were improved and 3 remained unaffected.

The prognosis of tuberculosis of the toe joints treated by roentgen rays may be considered very favorable in all types of cases. In the case of mid-tarsal involvement, the prognosis is equally good in all types of cases. In tuberculosis of the ankle more than half of the cases were rendered non-active as a result of the treatment; the fistulous cases rendered non-active were much more numerous among young patients, but in the purely fungous types adults and the young were equally benefited.

The results of treatment with mild roentgen doses are much better than those with heavy doses. In the latter group, 3 cases showed late injuries while in the group receiving mild treatment no injury whatever occurred. Warning should therefore be given against employing doses as high as the skin unit dose. Abscesses should be opened and drained. The injection of iodoform does not seem to be of considerable importance. Sequestra should be removed surgically as soon as they become distinctly demarcated. The treatment should of course include as far as possible general hygienic measures, open air, sunlight and good nourishment.

The roentgen treatment of tuberculosis of the foot joints should never be conducted without concurrent orthopedic treatment. In ambulant cases plaster-of-Paris bandages are recommended or other apparatus designed to relieve the affected joint from weight bearing. Braces should be used for a considerable time after the non-active stage has been produced. It is always advisable to try radiation in every case of tuberculosis of the foot joints. In fistulous cases among working people, one should not delay too long with operative intervention if two radiation treatments fail to procure a distinct improvement.

Keijser, S. Roentgen treatment of syringomyelia. *Acta radiol.*, 1926, vii, 37–50.

A tabulation is given of 53 cases of syringomyelia treated by radiation, all of the cases being under the observation of the same neurologist during the entire time of treatment. In only 6 of the cases, the condition continued to progress without apparent change. At no time was there any evidence that the treatment aggravated or accelerated the condition. In 11 cases the disease became stationary with respect to both the objective and subjective symptoms. One of these patients died and 2 were lost sight of; in 6 of the remaining cases the condition has remained unchanged for four to seven years.

In 15 cases there was both subjective and objective improvement. In an additional group of 18 patients, the objective symptoms remained unaffected by the treatment but there was a more or less distinct subjective improvement. In practically two-thirds of all cases there occurred a subjective improvement which was often so distinct that the patient himself spoke of cure.

The technique of treatment was as follows: The extent of the process was carefully determined by the neurologist. Each portion of the involved spinal column was irradiated over a field to the right and to the left of the median line, each field $6 \times 8$ cm. The rays were filtered through 0.5 mm. Cu or Zn plus 1 mm. Al, produced at 185 kv. Each field received $\frac{1}{2}$ to $\frac{2}{3}$ of the skin unit dose. In general, a second series was administered after six or eight weeks, and a third after a further pause of ten to twelve weeks. No skin injuries have been observed up to the present, except that one patient shows a mild telangiectasis, a case which received five series of treatments. The full skin unit dose has never been given owing to the fear that in this disease the skin might be more sensitive than normal.

Moberg, Ludvig. Roentgen treatment of eczema. *Acta radiol.*, 1926, vii, 201–213.

The treatment of eczema by means of roentgen rays is founded on empirical knowledge, although the study of the biological effect of the rays and the study of the histopathology of eczema have clearly demonstrated the beneficial influence of the treatment. Our knowledge regarding the fundamental nature of the rays is still incomplete so that a truly rational basis for the radiotherapy is still lacking. Roentgen treatment does not cure eczema; it is merely a means for local treatment which is sometimes capable of clearing up solitary eczematous foci, and it should be used in those cases where it favors healing better than other local medicaments.

The use of roentgen rays is contraindicated in acute eczema, largely on account of the danger involved which cannot be altogether eliminated. This danger is especially evident in the treatment of chronic eczema showing a tendency to recurrences *in loco*.

Olivecrona, H., and Lysholm, E. Notes on the roentgen therapy of gliomas of the brain. *Acta radiol.*, 1926, vii, 259–268.

Reports are given of 4 cases of verified gliomas. In one case the lesion was not found at operation and in the remaining cases operation disclosed inoperable tumors. The operation was in all cases terminated by a decompression, and roentgen rays were subsequently applied. Where the tumor was situated above the tentorium the operative procedure was an osteoplastic resection and exploration followed by a subtemporal decompression. In the cerebellar case a bilateral exposure with removal of the bone was carried out, the dura subsequently being left open. In 2 cases fragments of the tumor were removed at operation, in one case the lesion being considered verified by the presence of the characteristic clotting fluid in a small cyst within the tumor, and in one case at necropsy nine months after a negative exploration.

The roentgen rays for treatment were delivered at 180 kv., 2.5 ma., 0.5 mm. Cu filter, 30 cm. distance. Generally 2 or 3 fields, each measuring about 25 sq. cm. were treated. The number of fields was varied according to the situation of the tumor, cross-firing being employed as a rule. Whenever possible the decompression openings were used as portals of entry. No single large dose was given but each series of treatment was extended over a period of at least one week. The total dose delivered to the tumor during each treatment series was about 90 to 100 per cent of the erythema dose according to the Wintz standard. This dose usually caused epilation but no erythema. A second treatment was usually given not earlier than a month after the first.

As a result of the moderate roentgen treatment following decompression, 2 of the cases showed considerable improvement, one of these cases being a median, cerebellar neoplasm, probably a medulloblastoma, and the second a gliomatous cyst of the left hemisphere. In the other 2 cases the treatment was apparently without effect. Operation and, if possible, histological verification of the tumor should precede roentgen treatment since many brain tumors are susceptible either of surgical

removal or are not suited for roentgen treatment, as, for instance, the endotheliomas. In some cases of glioma, roentgen treatment may undoubtedly be of value, hence every case of glioma should be given the advantage of a postoperative roentgenization.

PFAHLER, G. E. The roentgen treatment of metastatic carcinoma of bone. *Acta radiol.*, 1926, vii, 280–288.

In the author's experience, the most frequent primary lesion preceding metastatic carcinoma in bone is, carcinoma of the breast, the prostate, the uterus or the thyroid. Of these, carcinoma of the breast with metastases is by far the most common. Such metastasis is occasionally found before the primary disease has been recognized or complained of by the patient. The spine is most frequently involved and should be studied roentgenographically in all advanced cases. Healing can be obtained by means of roentgen treatment even when there is an associated spontaneous fracture.

Only local curative results and a prolongation of life from one to four years can be expected. The local healing is indicated by a recalcification of the affected part. Involvement of other parts of the body must be continually expected. Moderate dosage of roentgen rays continued over a long period of time, preferably with high voltage radiations, appear to give the best results. The aim in treatment must be to destroy the diseased cells but not to destroy the osteoblasts upon which recalcification depends. No deleterious effects of the radiation upon the blood or the general condition have been noted in the cases treated by the author. Brief reports are given of 5 cases, all of which improved under treatment.

QUICK, DOUGLAS, and CUTLER, MAX. Transitional cell epidermoid carcinoma. *Surg., Gynec. & Obst.*, 1927, xlv, 320–331.

Within the group of intraoral epidermoid carcinomata are found peculiar tumors presenting a specific histological structure to which the name "transitional cell epidermoid carcinoma" has been applied. Transitional cell carcinoma is a highly cellular malignant tumor. The cells are small, uniform in size, with large hyperchromatic nuclei and scanty cytoplasm, growing diffusely, sometimes forming solid cords. Adult squamous characters such as hornification, spines and pearl formation are absent. The exact origin of these tumors is as yet undetermined. It is believed that they arise either from the transitional epithelium or from squamous epithelium which in its growth loses its adult epithelial characters and assumes anaplastic features.

The most frequent seats of occurrence are the tonsil, base of the tongue, and nasopharynx. Tumors composed of this type of cell form a small but definite proportion of intraoral carcinomata. In the tonsil and the base of the tongue the proportion of transitional cell to squamous cell carcinoma is approximately one to ten.

The clinical course of these tumors is characterized by the early wide dissemination of the disease so that the clinical picture is dominated by the metastatic process, while the small deep-seated primary lesion in many instances remains undetected. A review of the cases shows many instances in which this disease has been erroneously regarded as bronchogenetic carcinoma, endothelioma and lymphosarcoma. This is due to the fact that the deep location of the primary lesion and its early metastasis causes enlargement of the cervical nodes before the primary tumor ulcerates and produces symptoms. Attention is called to the importance of thoroughly excluding a deep-seated primary transitional cell carcinoma before deciding on a diagnosis of primary disease of the lymph nodes. The marked radiosensitivity of transitional cell carcinoma is one of its most characteristic properties. This property is so marked that the rapid response to radiation is a useful point in the differential diagnosis from the radioresistant squamous carcinoma. The ability to completely eradicate the disease in the primary lesion and cervical nodes by irradiation renders this the method of choice in the treatment of this disease. An attempt to prevent distant metastases should be made by treating the lesion as early as possible by a method avoiding trauma in order to prevent disseminating this very cellular tumor process.

A review is given of 20 cases which are briefly reported. Thirteen of the patients treated are dead. Of the 7 still living the interval is too short to designate any as being cured. The results of the treatment of the primary lesion have been satisfactory in most cases; often there was complete regression of the disease without gross necrosis of tissues. The treatment consisted of irradiation with high voltage roentgen rays and radium for the cervical nodes, and gold radon implants in the primary focus. Examination of the irradiated specimens has shown in many instances complete destruction and devitalization of all tumor cells. The difficulty apparently lies in the early dissemination of the disease to the viscera so that whereas the primary lesion and cervical

nodes have been brought under control the patient succumbs from bulky visceral metastases.

Reyn, Axel. Phototherapy of radio-lesions of the skin. *Acta radiol.*, 1926, vii, 322–339.

The author has treated by means of concentrated light of the carbon arc (Finsen treatment) a considerable number of cases of ulceration, atrophy and other cutaneous changes caused by previous application of roentgen rays. This form of treatment has an undoubted value in the management of such cases. Emphasis is placed upon the importance of using carbon arc light. The employment of mercury vapor lamps has been followed in several instances by harmful reactions.

The effectiveness of the Finsen treatment may be judged from two facts. In the first place a number of cases have remained "cured" for several years after termination of the phototherapy. In the second place, even those cases "cured" recently present a skin which has lost its characteristic, roentgen-atrophic appearance and become smooth, soft and well nourished.

Schmitz, Henry. Radium and *x*-ray treatment in carcinomata of the uterine cervix. *Acta radiol.*, 1926, vii, 405–414.

In the author's technique the effort is made to maintain all the factors as constant as possible in order to avoid errors in the application of roentgen rays. The roentgen treatment factors are: 200 kv., 25 ma., 1 mm. Cu plus 1 mm. Al., 15 × 20 cm. field, 50 cm. focal skin distance, 25 min. exposure to each field, i.e., 625 ma-min. or about 10½ ma-hr. The upper border of each field corresponds with the height of the sacral promontory, and the lower border includes the level of the perineum. Thus the entire bony pelvis and the external genitals are included. A cervical carcinoma involving the lumbar lymph nodes is considered so far advanced as to be hopeless therapeutically. Consequently the author never extends the radiation fields above the sacral promontory. The author's 100 per cent skin erythema dose equals about 2300 e (Friedrich's electrostatic units), or about 1000 r. Three or four portals of exposure are employed.

Since the highest permissible skin dose of roentgen rays does not permit the application of a dose capable of destroying the greater number of cervical carcinomas, radium rays are added to the roentgen-ray dose. The radium capsules contain 25 mg. element enclosed in a silver capsule of 0.5 mm. wall thickness. Two such capsules are placed in a brass filter 1 mm. thick. The treatment should be such that the vesical and rectal mucosa should never receive a combined roentgen and radium dose greater than 180 per cent of the skin erythema dose. The author's combined roentgen-ray and radium method is essentially a modification of that used by Opitz and Friedrich. The treatment is almost invariably followed by vesical and rectal irritation but this is only temporary and usually abates within ten to fourteen days.

The indications for radiation treatment of primary cervical carcinoma are determined by a careful physical examination by which the exact extent of the cancer is ascertained. Based on the examination, the cases are grouped: Group 1 comprises cases in which the growth is clearly localized to the cervix. Group 2 includes cases which show a doughy or swollen consistency of the paracervical tissues. Group 3 comprises cases in which the parametria, the contiguous organs or regional lymph nodes are found invaded but the invaded structures are not yet rigidly fixed. Group 4 includes the advanced cases with frozen pelvis, extensive necroses, distant metastases, and advanced cachexia. The indications for treatment are: Group 1, surgery; Groups 2 and 3, radium and roentgen rays; Group 4, symptomatic and palliative treatment.

Between 1914 and 1920, 183 cases were observed and treated. Of these, 116 were followed up. Of the total number there were 10 belonging to Group 1 and 8 cases were alive and well at the end of five years. In Group 2 there were 21 cases with 7 alive and well at the end of five years. In Group 3 there were 93 cases with 11 alive and well at the five-year period. Group 4 included 59 cases, all of whom succumbed before the five-year limit. Comparison of the results from various clinics shows that a high percentage of operable cases yields a high percentage of absolute cures and vice versa. The relative percentage of cures obtained by radiation methods, however, compares favorably with that obtained by surgical methods.

Scholander, Axel, and Tengwall, Ernst. A case of roentgen treated inoperable cancer of the stomach with prolonged improvement. *Acta radiol.*, 1926, vii, 415–418.

The case occurred in a man aged fifty-seven, who showed at an exploratory laparotomy a knotty tumor about the size of a saucer in the fundus of the stomach. The appearance of the tumor was that of a typical carcinoma. It was fixed laterally and anteriorly to the abdominal

wall, and the omentum near the larger curvature contained several hard glands.

Roentgen treatment was given. The exposures were made at a distance of 20 cm. through five fields, three abdominally and two dorsally. Each field received three-fourths of the skin erythema dose, through 0.5 mm. Cu, 140 sklerometer reading, 2.5 ma. Only one field per day was irradiated. Following the treatment the tumor showed an astonishing regression, as determined roentgenographically (estimated decrease at least 75 per cent). Another series of roentgen treatments was given a month later. Following this the roentgen examination showed no filling defect and the contours seemed smooth. However, the stomach seemed to be somewhat smaller as if caused by contraction at the greater curvature. Following this the patient felt perfectly well, without any symptoms and in addition, increased in weight. A year and a half after beginning of the treatment metastases made their appearance in the left clavicle and humerus.

SCHOUTE, D., and ORBAAN, C. The treatment of cancer of the breast with and without subsequent roentgen treatment. *Acta radiol.*, 1927, viii, 239–244.

Of 78 cases in which cancer of the breast was treated by operation, only 42.3 per cent were alive and in good health after three years, and 35.9 per cent after five years; of 28 cases in which operation was followed by roentgen treatment, 57 per cent were alive and well after three years and 44.4 per cent after five years. The roentgen treatment was given ten days after operation. The operated area was divided into four parts and where necessary the supraclavicular fossa and the axilla from behind were irradiated. Each field received 8 H at 150 kv., maximum, filtration through 0.5 mm. Zn or 0.5 mm. Cu. The results indicate definite advantage of postoperative irradiation and that improvement in roentgen treatment may be expected to lessen the number of local recurrences.

SCHREINER, BERNARD B. A summary of the methods and results in the treatment of cancer. *Acta radiol.*, 1926, vii, 419–452.

A review is given of 3,246 cases of malignancy treated at the State Institute for the Study of Malignant Disease, Buffalo, N. Y., between May, 1914, and May, 1925. The material was carefully classified at the time of admission into groups where the disease was still local and where there were regional or disseminated metastases.

Basal cell epithelioma of the skin was treated entirely by radiation, with primary healing in 95 per cent of the cases and permanent healing in about 75 per cent for periods varying from one to six years. In epithelioma of the lip clinical healing was obtained in 78 per cent of cases with tumor confined to the lip. With movable regional metastases 39 per cent have remained well three years or longer. The far advanced cases gave no clincal healing. In 7 out of 13 early cases of epithelioma of the penis without demonstrable metastases clinical healing was obtained for periods varying from two to ten years; in 24 cases showing small metastasis in the inguinal nodes 4 showed clinical healing from one to seven years. There were 31 cases of epithelioma of the vulva and clitoris and 4 treated by implantation of radium and coagulation showed satisfactory results for periods up to two and a half years.

There were 375 cases of cancer in the oral cavity treated by implantation of radium emanation and high voltage roentgen rays, with healing up to eight years in over 6 per cent to 50 per cent of the cases, depending on the reaction of the primary lesion and presence of metastases. In epithelioma of the antrum of Highmore clinical healing was obtained in 5 out of 23 early cases where the disease was localized. There were 23 advanced cases with metastases and only palliation was obtained. There were 8 cases of adamantinoma and 4 have remained well for periods up to seven and a half years. The treatment of tumors of the larynx, esophagus and branchiogenic remains has yielded only palliation.

In epithelioma of the vagina 4 out of 8 early cases, and 2 out of 25 advanced cases have been clinically well up to three years. In epithelioma of the cervix 93 per cent of group 1 cases were clinically healed. Group 2 showed 56 per cent and group 3 27 per cent clinically well. Group 4 cases showed palliation only. In adenocarcinoma of the cervical canal clinical healing was obtained in 4 out of 7 early or so-called operable cases. Cancer of the fundus of the uterus has been clinically healed in about 72 per cent of the operable cases up to three and a half years. Eleven out of 184 cases of cancer of the rectum and anal ring have remained healed for eight months up to four years. Palliation was obtained in 65 cases of cancer of the bladder but in only one case was there absolute clinical healing lasting over two years. Carcinoma of the prostate, of the thyroid and inoperable cancer of the stomach have yielded palliations lasting for variable periods.

The method of choice at present in the treatment of early cancer of the breast should be

surgical but always followed by divided doses of high voltage roentgen rays. The results in cases of mixed embryonic tumors of the kidney were unfavorable. Radiation therapy has been satisfactory in bringing about remissions in the treatment of myelogenous and lymphatic leucemia which, however, were of relatively short duration. It has been found that radiation and arsenic medication has yielded apparent clinical healing in 13 out of 38 cases of round cell sarcoma in which the disease was local or possessing regional metastasis. The period of healing has been up to six and a half years. In so-called sarcomatosis the results have been only palliative. Radiation in the treatment of sarcoma, particularly the giant cell, spindle cell, and melanotic, has proven of real value.

SIMPSON, FRANK E. The treatment of intraoral cancer with radium emanation. *Acta radiol.*, 1926, vii, 491–503.

In the treatment of intraoral cancer both the primary lesion in the mouth and the lymph nodes of the neck must be considered. There are two chief methods for using radium emanation, namely, massive radiations to the surface of the tumor and intratumoral insertion of bare glass tubes. The intraoral lesion may be treated by a combination of both methods. Intratumoral irradiation should nearly always be preceded by a surface irradiation, a procedure which theoretically minimizes the danger of metastasis. For this purpose, 1000 mc. may be applied to an area of from 4 to 6 sq. cm., at a distance of 2 mm. for five minutes. In using intratumoral radiations bare glass tubes containing 0.5 to 1 mc. radium emanation are used. These tubes are allowed to remain permanently in the tissue. They either become encysted or slough out in the course of the healing process. As a rule, only one intratumoral treatment is necessary. Healing takes place in from six to twelve weeks but it may be delayed much longer. Lesions that are favorably situated, e.g., cancer of the buccal mucous membrane should always be irradiated from the external surface so as to get a cross-fire effect.

Between 1919 and 1924 the author has treated with radium emanation 141 unselected cases of intraoral squamous cell epithelioma, of which 115 were diagnosed clinically and microscopically. In the latter group there were 30 cases with involvement of the tongue. Nineteen of the 115 cases could not be traced. One was in poor condition. Three abandoned treatment. Forty-five were dead and 47 clinically well. Of those dead, the longest duration of life was three years, the average duration thirteen months. Of the 47 cases with and without nodes alive, the longest duration of cure is five years and the average duration two and a half years.

WETTERER, J., and GAA, F. Therapy of skin cancer. *Acta radiol.*, 1927, viii, 46–50.

A description is given of a case of carcinoma of the skin with over 300 large and small nodules distributed over the scalp, face, ears, throat and neck, in a woman aged forty-seven. The type of cancer was little sensitive to irradiation, being of the adenogenetic type with small tendency to growth. The authors succeeded in removing every nodule, with a cosmetically excellent result and completely restoring the patient who had already become somewhat cachectic. The treatment consisted of a combination of fractional roentgen-ray irradiation, injections of blood serum and glucose and prolonged deep electrolysis.

## MISCELLANEOUS

GUTHMANN, HEINRICH. The dependence of the biological effect upon the dose of roentgen rays. *Strahlentherapie*, 1927, xxv, 280–287.

Experiments were made upon *B. typhi muris* and upon the ovary. When bacteria are exposed to unfiltered roentgen rays of 180 kv., indefinitely large doses may be applied without decrease in the bacterial numbers, showing that most of the rays pass through the organisms and are not absorbed by them. On the other hand, it is known that metals exposed to roentgen rays give off a characteristic radiation which is very easily absorbed. By employing copper radiators 0.1 mm. thick the author was able to demonstrate a uniform bactericidal effect due to the radiations, which followed the exponential law. Experiments were also performed upon the human ovary. There were 291 cases which have been exposed to three different doses of rays. As a measure of effectiveness of the doses the author chose the time period after exposure at which menstruation ceased. The series of cases could be divided into three groups: The first those treated with a dose of 25 to 30 per cent of the skin erythema dose; the second those receiving 35 to 40 per cent, and the third those receiving 80 per cent of the skin erythema dose at the ovary. These three groups could be further subdivided to account for cases irradiated during the first half of the intermenstruum and those irradiated during the second half of the intermenstruum. An analysis on this basis, considering the cases exposed during the first half of the intermen-

struum, showed an increasing percentage of menostasis in the three groups from 48.3 per cent to 71.4 per cent to 92 per cent with increasing dose. This was even more pronounced in the cases exposed during the second half of the intermenstruum. In this study of irradiation of the ovaries, a mathematical analysis discloses an exponential relation similar to that found in the studies with bacteria. The outstanding feature of the curves obtained is the fact that the effect of a small dose is increased considerably by a small increase in dose, whereas a corresponding increase of large doses produces relatively slighter effect. The bearing of this upon treatment for menostasis, temporary or permanent, becomes apparent.

Hausser, K. W., Bardehle, A., and Heisen, G. Ray protection in roentgen diagnosis and diagnostic tubes, with remarks on oblique radiation, scattered radiation and metallic beryllium. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 636–647.

The requirements for ray protection in roentgen establishments are reviewed, and the authors propose a maximum permissible dose for places where humans are usually present in roentgenoscopic rooms. This is an amount of radiation equal to $5 \times 10^{-3}$ R per second, equivalent to a skin erythema in 2500 hours. This proposal is based on the findings of Mutscheller and also upon values obtained in practical roentgenoscopic manoeuvers performed in a manner analogous to that described by Glocker.

In studying the question of protection against different forms of scattered rays escaping from the roentgen tube, consideration was given to the roentgen radiation (oblique radiation) produced from portions of the anticathode other than the focus. Experiments have shown that by placing flanges of heavy metal around the anticathode the deflected electrons are absorbed in a satisfactory manner. By introducing such flanges or mantles and also adequately surrounding the electrodes with heavy metal, a considerable degree of protection from unwanted radiations is attained. Moreover it has been discovered that the light metal beryllium gives off an almost insignificant amount of characteristic radiation, although it transmits roentgen rays with a very high degree of efficiency. Accordingly in the newer protected tubes there is included, in addition to the above heavy metal shields, a beryllium screen in the path of the roentgen beam so that practically all unwanted radiations are excluded from the roentgen tube output.

Hausser, K. W., Bardehle, A., and Heisen, G. Reply to Thaller's article entitled "What Requirements Must Be Absolutely Satisfied by Protected Roentgen Tubes in Order Not to Endanger Physician or Attendants?" *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, xxxv, 647–650.

The authors point out that Thaller used a qualitative, photographic method to detect the presence of radiations but made no actual quantitative measurements. The claim by Thaller that all radiations should be absolutely eliminated is physically impossible. If Thaller had made quantitative measurements he would have discovered that the escaping radiations were very slight at the point where the physician or attendant would be stationed. In this connection, attention is directed to the measurements made by Schlechter who made a thorough quantitative study of this aspect of the problem.

Hickey, P. M. Standards in roentgenology. *J. Am. M. Ass.*, Sept. 3, 1927, lxxxix, 776–779.

A consideration of what may be expected of practitioners in the now well-established field of roentgenology leads to the following conclusions: It is desirable that there be greater uniformity in teaching roentgenology to undergraduate students. The practicing roentgenologist should make a determined effort to require a higher standard of qualifications in those practicing this specialty. It seems desirable that a more uniform type of roentgen-ray reports be established in our clinics and hospitals and that a standard of nomenclature be adopted for the purpose of clarifying the literature.

Holthusen, H. The fundamental process of the biological effect of radiations. *Strahlentherapie*, 1927, xxv, 157–173.

The point heat hypothesis of Dessauer could be defended at least dialectically on the assumption that heat concept summarily includes all the processes which occur in equilibrium with each other at all temperatures. In this event, it would correspond to the hypothesis which was enunciated over a hundred years ago by Gay Lussac and Thénard. In order to explain the action of light on the chlorine hydrogen reaction, they believed with Count Rumford that it was sufficient to assume "that the light does no more than raise very greatly the temperature of the minute particles upon which it acts, even though the temperature of the whole mass is increased only slightly." This assumption of localized concen-

tration of energy, which was an attractive hypothesis for that time, repeats today something which is already a self-evident fact and no longer a subject for hypothesizing. In this age of quantum mechanics of the atom, it makes a rather belated appearance.

The point heat hypothesis does not satisfy all experience with respect to the action of heat and radiation on the mechanism of the response. If it is brought forward in the form stating that all movements of molecules and electrons are due to heat movements in the strict sense, i.e., the motions of translation of the molecules and their components are fundamentally responsible for the reactions to radiations, then it leads to unsolvable difficulties in explaining the actual behavior of proteins toward radiation (photosensitization, establishment of limits of effectiveness), which can be cleared up only by application of the quantum theory. Otherwise it finds itself in direct contradiction with experience.

The quantum mechanics of the atom show that the effects of roentgen irradiation occur in the following sequence, disregarding for the moment numerous variants. First, there occurs the absorption of the quantum of energy, then follows an emission of primary electrons, succeeded by molecular excitation (ionization); and the last process gives rise to two simultaneous processes, namely, heat movement and chemical reaction (photolysis, internal rearrangement). On the other hand, Dessauer's hypothesis assumes the following sequence of events: First comes the absorption of a quantum of energy followed by an emission of primary electrons which is succeeded by molecular excitation (ionization). Furthermore, according to this hypothesis only one process succeeds the last, namely, heat movement, which initiates chemical processes. This aspect of the Dessauer hypothesis is in direct contradiction with experience.

JUGENBURG, ANNA. The effect of roentgen irradiation on the nitrogen and sodium chloride metabolism. *Strablentberapie*, 1927, XXV, 288–303.

A study was made of 56 male guinea pigs all of approximately the same weight and age. Eight of the animals served as controls throughout the duration of the experiments. In the others, a preliminary metabolism period of three to four weeks was studied, and they were then irradiated at 40 cm. focal skin distance, from a Coolidge tube operated at 200 kv., 0.5 mm. Zn plus 3 mm. Al. Thirty-six of the animals received a dose of $\frac{1}{2}$ skin unit, the rest $\frac{1}{10}$. Only 3 animals survived the treatment with $\frac{1}{2}$ S.U.D. The results of the experiments show that exposure to roentgen rays causes considerable changes in the chloride and nitrogen metabolism of the animals. These changes consist in disturbances of nitrogen excretion from the organism and in a pronounced retention in the organs. This nitrogen retention in the organs is not associated with any increase in weight but rather with a more or less considerable loss in weight of the animal. It therefore seems evident that the death of the animal is due to interference with excretory function of the organism due to disturbances in metabolism. In the animals treated with $\frac{1}{2}$ S.U.D. the nitrogen content of the whole blood was lower than in the controls. On the other hand, in animals treated two months previously with $\frac{1}{2}$ S.U.D. the blood nitrogen was greater than in the controls. The greatest decrease in blood nitrogen was found in the animals receiving $\frac{1}{2}$ S.U.D. fourteen days previously and in these animals the nitrogen retention in the organs was at its highest levels.

While the quantity of excreted nitrogen after irradiation with $\frac{1}{2}$ S.U.D. decreased with time, there was, on the other hand, an increased excretion of chlorides in the urine. At the same time the quantity of chloride in the organism decreased. In this connection it should be mentioned that this chloride ebb could be neutralized by feeding salt. Parallel with the chloride excretion there was a diuresis during the first few days after exposure.

LAZAREW, N. W. On the changes of the functional condition of the blood vessels after roentgen irradiation. II. The effect of roentgen irradiation on the subsequent development of inflammatory processes. *Strablentherapie*, 1927, XXV, 255–279.

Experiments were made upon rabbits; one ear was irradiated with $1\frac{1}{2}$ skin erythema units through 1 mm. Al, the other ear being used as control. At definite intervals from five minutes to three months after irradiation an experimental inflammation was produced by immersing both ears for three minutes in hot water (53°C.) or by rubbing in of croton oil. In the experiments in which the inflammation was produced within two weeks after irradiation the temporary functional hyperemia and also the inflammatory hyperemia was greater in the irradiated ear than in the control. Inflammatory edema also was greater in the irradiated ear. Terminal necrosis occurred oftener in the irradiated ear and was more extensive. Inflammations produced two to five weeks after irradiation resulted in functional and inflammatory hyperemia, also inflammatory edema

of approximately equal intensity in exposed and control ears. When the inflammation was produced five to eight weeks after exposure the results were variable. In a portion of the experiments the functional and inflammatory hyperemias were more pronounced in the exposed ear than in the control; in another portion both hyperemias were approximately of the same intensity in exposed and control ears. In all cases the edema was either of the same intensity in both ears or was somewhat stronger in the control. In all cases observed to the end the process of demarcation at the boundary of the mummified sections proceeded more slowly in the exposed ear than in the control. Comparison of these results with analogous facts concerning the alterations in functional condition of the vasomotor system following roentgen irradiation as determined by pharmacodynamic studies of the irradiated rabbit ear by the method of Krawkow the following generalizations seem to be permissible:

The changes in functional condition of the peripheral blood vessels following roentgen exposure progress in the form of single waves of reaction separated from each other by a definite time interval. In the rabbit ear two such waves of reaction could be observed in the course of two months. The first, with a peak occurring in the second half of the first day after exposure, corresponds evidently to the early reaction; the second, which is apparently the "true reaction," has its maximum about two months after exposure. Both waves can be demonstrated even in those cases showing no clinically visible reaction.

Each wave of alteration in the functional condition of the vasomotor system makes itself evident by an augmentation of the excitability of the vaso-dilating apparatus. In cases with pronounced reaction there is associated with the dilatation a decrease in excitability of the vaso-constrictor apparatus, the "reaction waves" becoming detectable by the unaided eye. With smaller doses (a little over one-half the rabbit erythema dose) the first wave always makes its appearance but the second may be missing. The early reaction therefore appears to represent a constant phenomenon, at least with unfiltered and slightly filtered radiations, and apparently more constant than the so-called "true reaction." With larger doses (about one rabbit erythema dose and over) both waves are as a rule detectable in the course of two months. A number of variations of the two-wave reaction of the vessels may be observed, depending on the degree of alteration in the vasomotor response attained in each of the reaction waves and also depending on the degree of return to normal vasomotor function during the interval between waves.

Macht, David I., and Reddish, George F. Effect of radium on pharmacological properties of mercurochrome. *Proc. Soc. Exper. Biol. & Med.*, Jan., 1928, xxv, 299–300.

The action of alpha and beta radiations were studied by crushing glass globules containing radium emanation in doses of 4 to 10 mc. directly under an aqueous solution of 2 per cent mercurochrome and immediately stoppering the vials tightly. The effect of gamma rays was studied by placing vials of mercurochrome solution in juxtaposition to large quantities of radium. Similar studies were made of the solid crystals. The bactericidal tests were made on a culture of *B. typhosus*. It was found that when solutions treated with alpha and beta radiations were examined within twenty-four to forty-eight hours there was a slightly increased bactericidal activity. This property, however, disappears after a few days. Exposure of the disinfectant to 3,500 mc. for one to ten hours revealed no increase in the bactericidal action. Pharmacological studies of the irradiated samples on living seedlings of *Lupinus albus* also showed a slightly increased toxicity of the drug. The increased toxicity disappears after a few days. Tests on animals showed no change in the potency after various irradiations.

Mainoldi, P. Distribution of roentgen energy at various depths; study of dosimetry with Palmieri's "diffusor." *Radiol. med.*, April, 1928, xv, 372–387.

The author has made many experiments with the "diffusor" devised by Palmieri in order to determine which of the arrangements possible with this apparatus are best for obtaining a suitable dosage at different depths. For this purpose he took ionometric measurements with the apparatus of Solomon.

He first describes the apparatus and then gives the results of his experiments and the conclusions that can be drawn from them. He touches on some important theoretical questions with regard to the effect of secondary irradiation on the depth dose and concludes that the arrangement that gives the best dosage at different depths is one in which lateral diffusion masses are used with a paraffin filter above them and metal filters immediately above the latter. With this arrangement he has been able to obtain a dosage of 93 per cent at a depth of 2 cm. and of 39 per cent at a depth of 12 cm. When it is desirable to obtain the largest dose possible at a slight depth (2 cm.) and a rapid fall of the dosage in the successive layers,

the most effective arrangement is the use of lateral masses with a filter of wood above and metal filters below, which gives a dose of 96 per cent at a depth of 2 cm.

Pohle, Ernst A. Limit exposure in radiography. *Radiology*, July, 1927, ix, 65–67.

After discussing the importance of estimating the physical and biological units and in pointing out the different standards suggested by different authors, the writer gives a table summarizing the methods of four roentgenologists as compared with his own. While the figures presented are regarded as relative values and correct only for the apparatus and tube used by the author, he states that no ill effects should follow the use of half the energy given as his erythema dose, after correction for different current through the tube and different distance. The erythema doses in R units used by the writer are 560 for 75 kv. and 450 for 100 kv. The same amount of roentgen energy may be used again after a month in most cases. No diagnostic exposure should be done without inserting a 1 mm. aluminum filter between tube and patient.

Pool, Eugene H. Malignant growths of the thyroid. *Ann. Surg.*, 1927, lxxxv, 120–128.

Confusion with regard to malignant growths of the thyroid is due to three factors: (1) the apparent rarity of malignancy in the thyroid has resulted in a somewhat limited opportunity for observation and classification; (2) the histological pictures vary considerably so that even well-trained pathologists often find it difficult or impossible to determine from the tissue sections whether or not there is malignant growth; (3) a careful follow-up as a means of determining the true condition in doubtful cases has been generally neglected.

A review of the evidence indicates: (1) most malignant growths of the thyroid originate in pre-existing adenomata; the incidence of such development is uncertain; (2) the histological picture is often not conclusive either for or against malignancy; (3) true vascular invasion is a conclusive criterion of malignancy; this feature, however, is difficult to recognize. (4) The long-accepted teaching that metastases occur from benign goiters is unsupported by facts.

Sixteen malignant growths of the thyroid have been observed at the New York Hospital in recent years. Fourteen of these cases were carcinoma and 2 lymphosarcoma. The postoperative results in the series of carcinoma cases are as follows: 5 died within eight months of local extension or metastases; 3 died in about three years with metastases; 2 were lost in the first and second years respectively but presented local recurrence; one was a postoperative death. There are 3 apparently well, less than one year after operation. The 2 cases of sarcoma died within eight months with local extensions. In view of the uncertainties of operation in advanced cases, irradiation must be given serious consideration. Most radiologists agree that carcinoma of the thyroid is remarkably sensitive to radiation.

Removal of adenomata is the best means of treating cancer of the thyroid. It constitutes a prophylactic procedure. If carcinoma is discovered after the removal of an adenoma, thorough postoperative irradiation is indicated. Cancer not limited to an adenoma is rarely cured by surgery. When the clinical diagnosis of cancer is definite, irradiation is in general preferable to bold efforts at radical extirpation.

Quick, Douglas, and Cutler, Max. Neurogenic sarcoma. *Ann. Surg.*, 1927, lxxxvi, 810–829.

In the belief that most of the spontaneous and intermuscular tumors commonly designated as fibrosarcoma, spindle cell sarcoma and fascial sarcoma are of neurogenic origin, all tumors presenting these features have been included under the term neurogenic sarcoma. The serious nature of these small movable subcutaneous tumors is generally unrecognized and they are commonly regarded as benign fibromas. Repeated incomplete excisions frequently result in local recurrences in a stage of the disease in which irradiation and adequate surgery would result in a cure.

Because of the radioresistance of neurogenic sarcoma and the radiosensitivity of tumors with which they may be confused clinically, the therapeutic test may be of practical value in the differential diagnosis. Of 24 patients with tumors of the extremities (excluding tumors of the thigh) 12 died and 12 are alive and free of disease from three to nine years. Five of the cases are amputation cases and 7 are cures effected by the conservative measures of excision or irradiation or the combined method. Neurogenic sarcomas of the thigh offer a bad prognosis; only 2 out of 15 patients being alive. The structure frequently encountered in this group is myxosarcoma. The unfavorable location and the high grade of malignancy account for the unfavorable results. Ten amputations for tumors of the extremity resulted in 5 cures and 5 deaths from pulmonary metastasis. The histological structure in the amputation failures was unusually cellular and highly malignant. It is believed that the result of

amputation depends upon the degree of malignancy rather than upon the extent of the disease.

Eighteen patients with neurogenic sarcoma are well and free from disease from three to nine years. Seven had small operable tumors cured by excision and postoperative irradiation. Of 11 advanced tumors, 5 were cured by amputation, one by wide local excision and 5 advanced, inoperable cases are excellent results obtained by intensive, external and interstitial irradiation. Twenty per cent are known to have developed pulmonary metastases. In no case was pulmonary metastasis observed from the acellular fibrous type of growth.

An analysis of the failures reveals three outstanding features: high malignancy, advanced stage of the disease and inadequacy of treatment. Hence, inadequate irradiation is held responsible as one of the factors in the unfavorable results. Since the degree of malignancy cannot be determined clinically, pre-operative irradiation is indicated in all neurogenic tumors in an attempt to obviate the rapid recurrence following simple excision of the very malignant type. Heavy external irradiation alone or combined with interstitial irradiation are the methods to be employed in the treatment of the inoperable tumors. This results in relief of pain and arrest of the disease in many cases, and complete cure in some.

The authors' studies indicate that pre-operative irradiation followed by wide local excision and immediate postoperative irradiation is the method of choice in the treatment of the distinctly operable neurogenic tumors (excluding the extremely cellular type). The rapid response of the soft part subcutaneous tumor to external irradiation is an indication of its highly cellular and malignant nature and a contraindication to either interstitial irradiation or surgical removal. Prolonged external irradiation is the method of choice in the treatment of this type of growth. Brief citations are given of 17 cured cases in this series.

Reid, William D., and Kenway, Florence L. The action of tetraiodophenolphthalein on the heart. *Radiology*, Aug., 1927, ix, 162–163.

The injection of tetraiodophenolphthalein does not have a significant effect on the heart. Thirteen patients were studied electrocardiographically and no alterations from the control electrocardiograms were consistently present.

Roffo, A. H. Roentgen irradiation of spleen tissue cultivated *in vitro*. *Bol. Inst. de med. exper. (etc.)*, 1927, iii, 328–355.

The author has continued his work, begun some years ago, in irradiating splenic tissue cultivated *in vitro*. In some cases the tissue was irradiated before the cultures were made, in some cases during the process. Photomicrographs of the cultures are given and also tables showing the details of the results. The experiments show that the rays do not have any effect on the growth of the tissue, whether given before or during the cultivation. Microscopic examination of the cultures, either directly on hot platinum or of smears fixed and stained with hematoxylin, showed that after three days the tissue had grown to four times the volume of the original tissue and that the growth was the same in the irradiated specimens as in the non-irradiated controls. Two types of cells developed at once, one round and motile, the other elongated and with the characteristics of fibroblasts which contained many drops of lipoid; there were mitochondria which stained perfectly with neutral red in spite of the intense irradiation.

The action on this splenic tissue was the same as on the other tissues that have been studied previously—connective tissue, heart muscle and tumor tissue. Not only are the signs of life preserved in these tissues but they grow as well as the controls, showing that the rays have little effect. Even when various wave lengths were used and doses much larger than are ever used in practice the cells were still unaffected. The whole spleen was irradiated immediately after extirpation and small pieces after the cultures were started but the results were always the same. And even taking into account the latent period and making the cultures seven days after the irradiation there was no effect.

This resistance of the cells to the action of the rays *in vitro* must be due either to conditions which exist in the cells themselves or in the medium in which they are growing. It cannot lie in the cells for according to the law of Bergonié and Tribondeau the cells of the spleen undergoing cultivation *in vitro* would be particularly sensitive to the rays because of their embryonic character. So the results must be due to some factor in the new biological medium in which the cells develop removed from the influence of any hormones.

Roffo, A. H. Roentgen irradiation of tissues cultivated *in vitro* at different periods. *Bol. Inst. de med. exper. (etc.)*, Dec., 1927, iii, 491–502.

The author reports experiments in irradiating normal tissues and tumor tissue with roentgen rays. In this series of experiments the cultures

were made up to periods of as long as thirty days after the irradiation, which is longer than the period accepted by radiologists as the latent period. Some of the tumor tissues were irradiated in the living body of the animal and some of them after resection. But in all the experiments the cells lived and developed in the irradiated tissues just as in the non-irradiated controls.

These experiments show that the action of the rays is not due solely to the electronic action of the irradiation on the cells themselves. The action is more complicated than that, for the cells developing *in vitro* are not changed directly even when massive doses are used. This effect must be due to the action of the medium in which the cells are developing.

Salotti, A. Roentgen study of the immediate effect of operation and anesthesia on the heart. *Radiol. med.*, April, 1928, xv, 388–404.

The author made experiments and roentgen examinations for the purpose of determining the resistance of the heart to operation; he made a systematic preoperative and postoperative examination of 23 subjects and illustrates his article with preoperative and postoperative orthodiagrams of some of the cases. He tried particularly to determine the value of the direct and indirect tonic reflexes, making use of the orthostatic tests of Schrumpf-Martinet and Cardarelli-Katzenstein, and the contractile function as shown by the character of the pulsation, as manifestations of the strength of the myocardium and the reserve energy available for use in the demands made by operation.

He finds that in the normal heart operation and anesthesia do not cause morphological and functional changes which can be demonstrated roentgenologically. In hearts in which the tonus of the myocardium is changed and there is a disturbance of contractility operation brings about a more or less marked dilatation that can be demonstrated roentgenologically. This dilatation cannot be attributed to the anesthesia alone, for it sometimes occurs in subjects operated on under local anesthesia. In such hearts ether has a bad effect on the character of the pulsations while local anesthesia does not seem to affect it.

Schaefer, Walter. Experimental study on the effect of roentgen rays upon bacterial inflammations. *Strahlentherapie*, 1927, xxv, 370–372.

A series of rabbits were infected locally with *Staphylococcus aureus*, irradiated, and later on studied histologically. Each animal received 20 per cent of the skin erythema dose, filtered through heavy metal, at 30 cm. skin focus distance. The skin erythema dose of the apparatus used was 450 R. The exposures were made locally, the rest of the animal being shielded by lead plate. The histologic study included the skin, subcutaneous connective tissue and the muscle lying underneath.

Thirteen hours after irradiation of the normal animal the picture in the muscle tissue was very much changed while the skin and subcutaneous connective tissue showed nothing unusual. In the muscle there was an accumulation of cells described as proliferated perimysial cells. These cells reach their maximum on the sixteenth day. Examination of the irradiated and non-irradiated infected tissues showed no difference in the type of cells accumulating as a result of irradiation. There seems to be some difference in the quality of the cells in the muscle tissue and in the developing connective tissue indicating the healing process. In rabbits irradiated six hours after infection no difference could be observed in them and in those infected but not irradiated. It appears, therefore, that after a definite interval from the time of infection the tissue becomes especially sensitive to the irradiation, namely, when the classical symptoms of inflammation have made their appearance. It follows, therefore, that an inflammation cannot be prevented by irradiation. In every case a large or small abscess occurred after a certain period. It is, however, noteworthy that in the irradiated animals the abscess opened shortly after the irradiation, while in the unirradiated animals operation showed the abscess to be quite solid. In the irradiated animals the time for recovery was in general short as compared with animals not irradiated.

Schneider, Georg H. On the unification of nomenclature of roentgen irradiations. *Strahlentherapie*, 1927, xxv, 183–189.

Considerable confusion has arisen in the literature owing to the fact that different names have been given to the same dose and different doses have been described by the same name. In order to unify nomenclature of the different types of irradiation the suggestion is made that the term "mild irradiation" be used only as a general, comprehensive term for irradiations with doses lower than the threshold value for the ovary by direct exposure and characterized by menostasis. In the report of a definite treatment in any individual case the above term should be avoided. Under mild irradiations may be listed the two following classes: (1) minimal irradiation, by which is to

be understood the smallest systematic dosing with radiation, and also the dose for the treatment of inflammatory diseases as recommended by Heidenhain and Fried. (2) Ovarian stimulative irradiation which requires two to three times the above dose; like the above this also designates direct effect of the roentgen rays upon the ovary, or an indirect one on the particular organ treated by way of the vegetative nervous system without any direct function-stimulating effect in the irradiated region.

In contrast to these sub-threshold irradiations we have the direct strong irradiations producing necrobiosis and requiring doses which are always stronger than the demonstrable threshold dose. In this group are to be included: (1) the dose producing temporary castration, and (2) the dose producing permaennt roentgen amenorrhea and in these two groups the term mild irradiation should be eliminated.

Scott, W. J. Merle, and Whitaker, Lester R. Expulsion of its contents as a function of the gall bladder. *Proc. Soc. Exper. Biol. & Med.*, March, 1928, xxv, 420–422.

Further evidence is presented that expulsion of the gall-bladder contents is an inherent function of the gall-bladder and acts independently of purely mechanical factors. The fact that the gall-bladder may remain full for many days during fasting and that violent struggling with tube feeding in the cat produces no discharge of its contents is sufficient evidence that variations in intra-abdominal pressure within physiological limits do not cause emptying of the gall-bladder. Vigorous intestinal peristalsis produced by physostigmine as well as the normal movement of the barium meal through the intestine without effect upon the gall-bladder containing iodized oil would seem to rule out intestinal peristalsis as a significant factor.

Though the common duct be completely excluded, a fat meal will induce emptying of the gall-bladder through a cannula in the cystic duct, or the cut end of the common duct. In one cat whose gall-bladder had been filled with iodized oil, the hepatic and common ducts were injected from the gall-bladder after the ingestion of fat without the discharge of any oil into the duodenum. This can scarcely be interpreted in any other manner than as evidence against a reciprocal mechanism. Fat feeding in a cat with all the hepatic ducts tied off (as proven at autopsy) caused a characteristic discharge of 90 per cent of the gall-bladder contents into the duodenum. From the above recital of experimental facts, the conclusion seems inescapable that the expulsion of its contents in response to fat feeding is a vital function inherent in the gall-bladder musculature and independent of extrinsic and mechanical factors.

Spolverini, L. The inhalation of irradiated air in treatment. *Radiol. med.*, April, 1928, xv, 309–340.

The author discusses the different hypotheses that have been advanced to explain the mechanism of the action exercised on the organism in general and particularly on the internal organs by ultraviolet rays. On the basis of certain clinical, experimental and natural facts which are universally known and of certain principles of electricity he finds that when air irradiated with ultraviolet rays is breathed the active principles of the rays penetrate all parts of the organism. The air can be irradiated by passing it through a room which contains a powerful source of ultraviolet rays.

He made a thorough study of rickets in his institute with the object of determining the effect of inhalation of air irradiated with ultraviolet rays and found that even very serious cases of rickets could be cured in from one to four months by the simple inhalation of air properly irradiated, the inhalations being given three times a week. The good effect of the inhalations begins very promptly and continues even after the inhalations are stopped. The effect is particularly good in young infants and in cases that are treated early. Except for the skin affections the inhalation of irradiated air gives results as good as those obtained by irradiation of the body.

By special technical arrangements it is possible even in ordinary treatment cabinets to obtain an atmosphere with therapeutic properties very similar to those of sea air. The results obtained by this treatment explain in a rational way not only the general action of ultraviolet rays on the internal organs but the good effects of simple pure air treatment in various diseases. The treatment by inhalation of irradiated air is less expensive and less dangerous than ordinary irradiation. And it may even be rendered more active by a special technique. It is probable that in the near future children with chronic diseases, such as rickets, spasmophilia, lymphatism and simple anemia will be treated quickly and effectively by the inhalation of air charged with special substances, properly ionized and rendered photo-active by means of ultraviolet rays.

STOKLASA, JULIUS. The effect of radioactivity on the chemistry of sugar breakdown in the living cell. *Strahlentherapie*, 1927, xxv, 304–310.

Experiments show that the action of alpha rays or of emanation increases the intensity of respiration of chlorophyll-containing or chlorophyll-poor cells to a very considerable degree when the atmosphere contains 26.2 up to 83 mache units. The output of carbon dioxide becomes 40 to 90 per cent greater than when radium emanation is absent. In other words, radioactivity stimulates all enzymatic processes provided oxygen is present in sufficient quantity. The author believes that the primary breakdown of sugar is caused by the action of beta rays while oxygen respiration in the presence of oxygen is accelerated by alpha rays. These oxidative and reductive phases can take place, however, only in the presence of potassium and iron.

WARTHIN, ALDRED S., and POHLE, ERNST A. The effect of roentgen rays on the heart. 1. The microscopic changes in the heart muscle of rats and rabbits following a single exposure. *J. Am. M. Ass.*, Nov. 26, 1927, lxxxix, 1825–1828.

The precordium of 30 rats and 24 rabbits was exposed to roentgen rays of short wave length ($\lambda_{eff.} = 0.16$ Å) as used in deep roentgen therapy. The surface dose amounted to one human erythema dose, the roentgen-ray value to 1,100 roentgen-ray units. The animals were killed at various intervals after the treatment and the heart tissue was examined microscopically. No clinical symptoms representing the signs of roentgen-ray injury during or following the exposure could be noted; and there were no gross pathologic changes observable at autopsy.

The microscopic examination of the hearts of rabbits was positive in only one case. The unusual degree of Zenker's necrosis present in the heart of this animal cannot be explained by any other cause than irradiation. In 2 rats the microscopic changes in the heart muscle appeared to be marked enough to warrant its interpretation as a roentgen-ray injury. The remaining animals showing definite degeneration of the heart muscle belonged to a group exposed to higher doses.

The authors conclude from these investigations that the single exposure of the precordium to roentgen rays of the quality and quantity described and corresponding to one human erythema dose, does not produce definite and irreparable injury in the heart muscles of adult rats and rabbits.

WEINSTEIN, ALEXANDER. The production of mutations and rearrangements of genes. *Science*, Apr. 6, 1928, lxvii, 376–377.

Mutations and rearrangements of genes have been produced by Muller by subjecting the fruit fly *Drosophila melanogaster* to the action of roentgen rays. Similar experiments by the author have given results in entire agreement with those obtained by Muller. Through roentgen treatment there have been obtained mutations producing visible and lethal effects, as well as genetic modifications of the frequency of crossing over, and attachments between genes of different chromosomes.

The results do not show precisely how the mutation rate varies with the strength of treatment but they demonstrate the effectiveness of the treatment itself. There were 8 (possibly 10) mutant genes producing visible effects and 14 lethals in the 84 treated individuals, and none in the 56 controls. There seems no question that the genes can be modified and rearranged as a result of treatment with roentgen rays.

WYNEN, WALTER. The dependence of the roentgen dose on a preceding iodoform-glycerine injection. *Strahlentherapie*, 1927, xxv, 346–350.

Iontoquantimetric measurements show a considerable absorptive power of iodoform-glycerine for roentgen rays, as would be expected. It was of interest to determine if as a result of this absorptive power tissue injected with iodoform-glycerine would show an increased response as a result of secondary fluorescent radiation. Experiments were made on *Vicia faba equina* seedlings grown under or over layers of iodoform-glycerine and irradiated.

The result showed that irradiation of body tissues proximally or distally to a film of iodoform-glycerine yielded different tissue responses. In the first case there was an acceleration of the roentgen effect and in the second a decrease. These findings show that it is of considerable importance to know whether an iodoform-glycerine injection is made before or after a roentgen treatment. When the irradiation is made after injection the effective dose between the film and the roentgen source is increased as a result of secondary and fluorescent radiations. Distal to the film there occurs a decrease in dose as a result of filtration. The measurements show that this decrease is quite considerable and is of practical importance when considering tuberculous abscesses of the sternoclavicular joint, the sternum,

ribs and all superficial soft tissue abscesses including tuberculous lymphomas. In all such cases, the rule should be to irradiate first and then inject. If the iodoform-glycerine injection is made first, then irradiation causes an unnecessary injury of already pathologic skin and tissue response while the distal portions of the tuberculous abscesses receive an inadequate roentgen dose.

Alberti, W. A simple method for stereoroentgenography with the Bucky-Potter diaphragm. 1. Demonstration of the sella turcica. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 675–680.

A method is described for the stereoroentgenography of the sella turcica using the Potter-Bucky diaphragm. First adjustments are made as for a normal bitemporal exposure and the roentgen beam is cut down by a lead rubber aperture below the skull to the size of picture desired. For the first exposure the tube is shifted 3 cm. to the right and for the second an equal distance to the left of the midline of the Bucky diaphragm. By this procedure the quality of the picture is hardly affected. Before the second exposure, the cassette holder is drawn out of the Bucky diaphragm the width of the first picture so that the other half of the film lies under the opening of the diaphragm. After development, the film shows two exposures next to one another and these can be studied without further preparation and while still wet, by means of a simple hand stereoscope.

Artner, Hans. Procedure for legible marking of roentgen films and plates. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 778.

The inscription is made on the dry film and covered over with a 10 per cent solution of celluloid in acetone. This renders the written portion unattackable by the various solutions through which the film may be passed.

Daumann, W. Compensation of filament heating, its advantage and disadvantage. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 790–793.

Only the loss in voltage occurring in the circuit as a result of filament heating should be compensated. The compensating choke coil therefore belongs in the line before the step transformer. The degree of compensation should be adjustable to conform to the variations occurring in the main line and in the circuit. It is advisable to have the heating of the electron tube compounded, that is, so adjusted that it increases with increase in the load. This is preferably introduced directly before the roentgen transformer, that is, between the latter and the step transformer. An over-compensation of the filament heating is dangerous and often worse than no compensation at all. A compounding for tube and thermionic valve heating may easily cause puncture and damage of the roentgen tube, and it is therefore to be discarded as a faulty arrangement.

Frik, K., and Posner, K. The effect of roentgen rays on cell metabolism. *Ber. ges. physiol. exper. Pharmakol.*, 1926, xxxix, 363.

Flexner's rat carcinoma, Jensen's chicken sarcoma, chicken embryos and testes of mature rats and mice were irradiated with roentgen rays *in vitro* with a dose of 10,000 to 30,000 R. There was in all cases a 40 per cent reduction of anaerobic sugar breakdown. The respiration of testicle and retina was not altered. Aerobic glucose decomposition was somewhat increased in the testicle because of the diminished inhibiting effect of respiration. In the retina both aerobic and anaerobic sugar breakdown were reduced to almost zero. Irradiation with roentgen rays *in vivo* diminished the glucolysis of the tumors only when the irradiation was preceded by the injection of a large dose of glucose. The decrease of glucolysis amounted to 50 to 70 per cent as compared with the non-irradiated tumors.

Fritschi, G. Quantitative histological studies on the normal and roentgenized ovary of the guinea pig. *Acta radiol.*, 1927, viii, 209–238.

A single roentgen irradiation is sufficient to destroy the follicular apparatus. The corpora lutea appear to be unaltered. The Graafian follicles are more roentgen sensitive than the primary ova. It is however easy to destroy the whole follicular apparatus. With regard to the histological changes in the follicular apparatus and the intergenerative tissue, the observations made by the author corroborate those already reported by Lacassagne in 1913.

The quantitative histological examination shows that in normal, sexually mature guinea pigs the intergenerative tissue makes up the larger part of the organ, undergoes further development and increases markedly in size after puberty to attain its average maximum in animals eight months old, at which it remains until an advanced age when it falls off again. No quantitative changes were observed in the intergenerative tissues during the course of a pregnancy.

Exposure to roentgen rays did not result in

any absolute enlargement or increase of the interstitial tissue of the gland. The effect was a considerable and uniform reduction generally of one-fourth to one-third of its weight as determined on re-examination two months after exposure to the rays. All theories therefore which assign an endocrine importance on the basis of the merely superficial "deceptive" hypertrophy of the interstitial cells thus fall to the ground.

The follicular apparatus measured in absolute terms remains, on the whole, unchanged during the entire period of sexual maturity of the animal and becomes perceptibly reduced only with age. No marked inhibition of ovulation during pregnancy could be established. The weight of the whole organ and that of the interstitial tissue were found to increase with age in almost parallel fashion, reaching a maximum figure simultaneously and then becoming reduced somewhat with advanced age. No difference was noted in the size of the right and left ovaries.

Gartenmeister, Richard. Stereoscopic roentgenoscope apparatus with rotating, sheet lead screens to give optimum contrast. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 681–683.

A description is given of an apparatus for the use of two observers and employing two roentgen tubes. There are two lead disc diaphragms cut in segments and rotated so that each tube is alternately screened off and exposed so as to yield optimal conditions for contrast. The object of this construction is to permit the screen image to change 16 times per second. The result is the appearance of good structural detail with maximum utilization of the time of exposure. Practical experiments with this apparatus have not yet been performed.

Halberstaedter, L., and Vogel, K. Vascular ectasia of the laryngeal mucosa after roentgen irradiations. *Acta radiol.*, 1927, viii, 81–85.

Dilatation of vessels in an otherwise normal mucous membrane of the larynx apparently occurs in very rare cases and corresponds entirely to similar changes in the skin. The cases thus far observed have occurred in patients in young adult life treated with roentgen rays. The dilatations occurred simultaneously with marked roentgen changes in the skin, and atrophy of the soft parts occurred nearly always. It is, however, to be noted that not all cases which present external skin changes will show these vascular dilatations of the mucosa of the larynx. The mucosa seems otherwise entirely normal. The authors cite a few illustrative cases. In a series of 17 cases examined from one to ten years after roentgen treatment, 4 were found to show these vascular dilatations in the laryngeal mucosa.

Herfarth, Heinrich. Roentgenological observations on the vascular supply of the skin. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 715–729.

A study was made of the blood supply and ramification of the blood vessels in the skin. The procedure followed was similar to that of Bellocq. Contrast material was injected into the blood vessels of fresh cadavers and the various skin surfaces roentgenographed. The study was undertaken chiefly from the point of view of the plastic surgeon. In adults there was always found a double layered anastomotic net. The vascular systems were especially well developed in those areas which are exposed to continual pressure (as the soles of the feet and the palms of the hands), in areas subjected to increased tension and areas subjected to variations of temperature.

Herzger, Rudolf. The process of postmortem autolysis and proteolysis in macerated organs of guinea pigs treated with roentgen rays. *Biochem. Ztschr.*, 1927, clxxxiv, 341–358.

The roentgen treatment of guinea pigs results in a greatly increased postmortem autolysis and proteolysis of the liver and lung tissues. In addition, the serum of such animals has a proteolytic activity somewhat greater than normal and also a higher antitryptic titer. In hemolysis experiments, the serum of animals injured by roentgen treatment does not behave any differently than normal serum. *In vitro* irradiation apparently has no effect on the rate of autolysis and proteolysis of macerated normal organs. Serum from guinea pigs which have been repeatedly irradiated does not increase the postmortem autolysis of macerated organ from normal animals but shows a tendency to inhibit this effect. If bacteria are injected into irradiated guinea pigs and the animals are killed fifteen minutes later the pulp from their organs behaves like that from anaphylactic animals and the postmortem autolysis of the liver is greatly inhibited or even entirely stopped. The activity of the serum proteases is inhibited at the same time, while the antitryptic titer is greatly increased. Sixty minutes after the injection of bacteria, the animals already show signs of recovery, but the postmortem liver autolysis is still definitely inhibited, although less markedly than before.